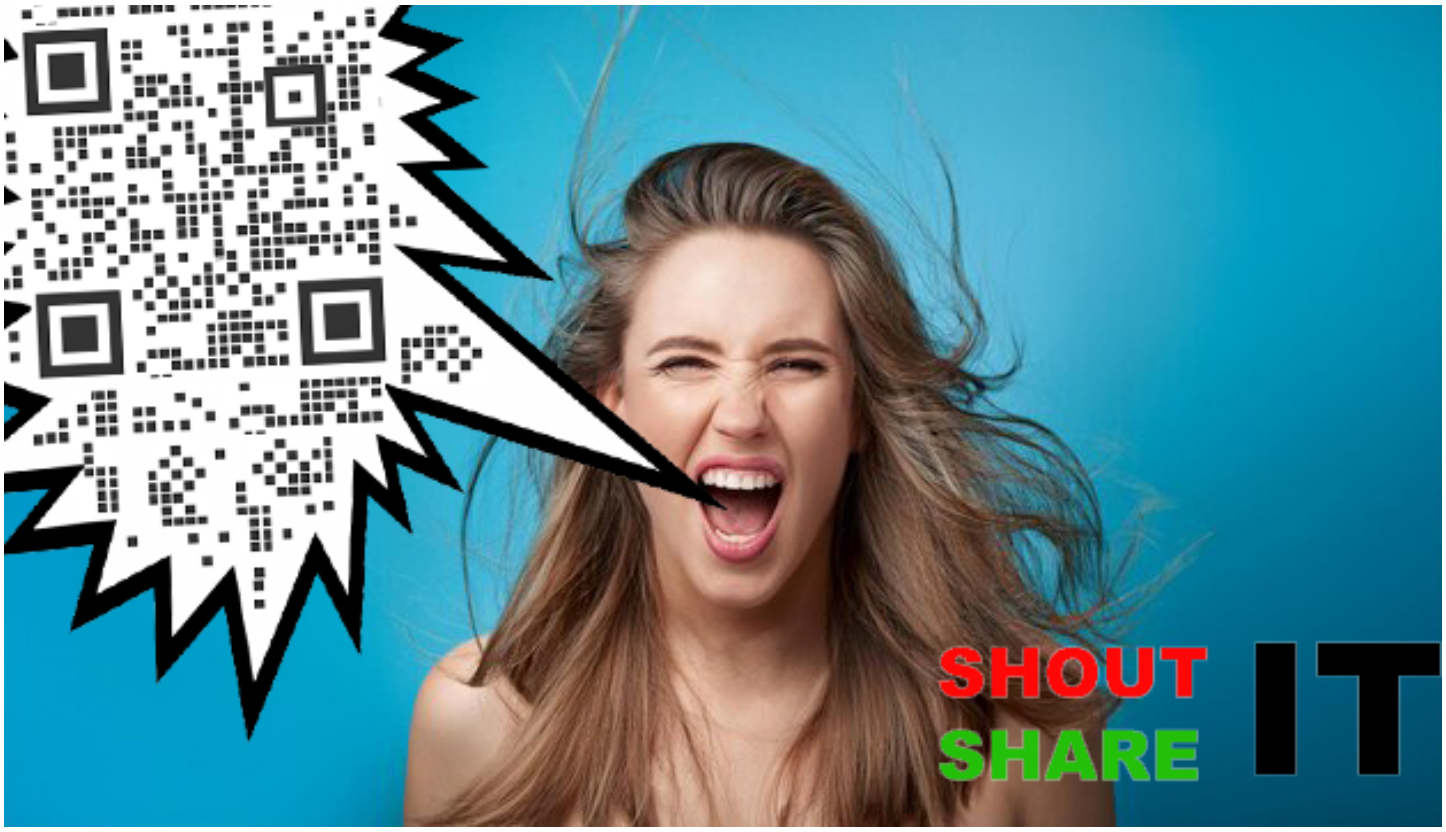
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MUSEUM OF NATURAL HISTORY

Host Relations of the Parasitic Cowbirds

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FRANK A. TAYLOR,
Director, United States National Museum.

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Preface

Cowbirds are an ideal group in which to study the biology of brood parasitism; within the six included species there are displayed all stages of the development of this mode of reproduction ranging from that of the non-parasitic bay-wing through those of the completely parasitic screaming, shiny, brown-headed, bronzed, and giant cowbirds.

The present report deals only with their host relationships, as this is the aspect of their biology in which our knowledge has shown the greatest increase since my initial over-all discussion was published in 1929.

It is assumed that the majority of users of this monograph will be interested chiefly in the common North American species, the brown-headed cowbird, *Molothrus ater;* accordingly, the more detailed discussion of this bird is presented first, constituting the major part of the report. This is followed by a shorter but similar treatment of the other North American species, the bronzed cowbird, *Tangavius aeneus;* then by a discussion of the two South American parasitic species, the shiny cowbird, *M. bonariensis*, and the screaming cowbird, *M. rufo-axillaris;* and finally by a discussion of the giant cowbird, *Psomocolax oryzivorus*, of Central and South America. The phylogenetic sequence is thus ignored for the interest and convenience of the reader. For a description of the phylogenetic relations of the included species, the reader is referred to pages 343–346 of my 1929 book. I know of no recent information that would cause me to suggest any alteration in the picture presented there, except that which is given in the present discussion of *Psomocolax* (see pp. 216–222).

For the two North American species I here submit complete annotated catalogs of their hosts, in answer to many requests that have come to me over the years from students and investigators of various ones of the included host birds. In the case of the South American shiny cowbird and the Central American giant cowbird, the unfortunate general lack of interest in birds in these areas has made it unnecessary to produce a similar new host catalog at this time, although our knowledge of the victims of both species has increased as greatly as that of their North American counterparts. Accordingly, I have included a complete tabular outline of the known victims of each of the races of the parasites, but I have written accounts only of newly added hosts and of those others of which our estimates as cowbird victims have been altered by recent information. Since there has

been little change in our knowledge of the screaming cowbird, only a short summary is given for this species.

Inasmuch as the completeness of our knowledge varies with the different species of cowbirds, the detailed discussion of such biological matters as host selection, the relative frequency with which different species of these hosts are utilized, the success rate with which these birds serve as fosterers, and the various reactions they give to the parasite and to the incidence of parasitism are all given in the account of each species of cowbird. As might be expected from the interest discussed above, the data are incomparably more extensive, and thus more amenable to analysis and interpretation, for the North American brown-headed cowbird than for any of the others. Because of this, the chief biological discussion and synthesis are given under that species, even though parts of the thoughts and conclusions are applicable to the others as well.

The present study of the host-parasite relations of the cowbirds has been a long time in progress. Not only has a great mass of data been accumulating slowly over several decades, but newer insights and better methods of evaluating and interpreting the facts have been brought to bear as the material permitted. Much of the present data is due in large measure to the kind cooperation of many observers, collectors, and custodians of collections, all of whom have generously sent me numerous interesting records that otherwise would not have been available.

As previously mentioned, my first discussion of the subject appeared in 1929, and short supplements, chiefly of new host species, have been issued at intervals between 1931 and 1949. Since acknowledgments were made in each publication to the individuals who contributed information, it is unnecessary to repeat them in the present work. However, those contributors subsequent to my 1949 paper are given here in alphabetical order. While it is true that many deserve a greater measure of thanks, all sent me what they could, and it is better to express my gratitude impartially.

I am indebted to the following for their contribution to the preparation of this work: Mrs. F. C. K. Anderson, Georgetown, Barbados; Dr. A. J. Berger, Ann Arbor, Michigan; Mr. D. A. Boag, Edmonton, Alberta; Mr. T. D. Burleigh, Washington, D.C.; Mr. E. A. Cardiff, Bloomington, California; Mr. E. J. Court, Washington, D.C.; Dr. I. McT. Cowan, Vancouver, British Columbia; Mr. R. S. Crossin, Tucson, Arizona; Mr. A. R. Davidson, Victoria, British Columbia; Mr. W. E. Godfrey, Ottawa, Ontario; Dr. P. Harrington, Toronto, Ontario; Mr. E. N. Harrison, Los Angeles, California; Mr. F. Haverschmidt, Paramaribo, Dutch Guiana; Gunnar Hoy, Salta, Argentina; Mr. J. B. Hurley, Yakima, Washington; Mr. J. D. Hyatt, Anniston,

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Host Relations of the Parasitic Cowbirds

A Comment on Cowbird Parasitism

It is obvious that the host-parasite relation is an essential aspect in the appraisal and understanding of any given example of a parasitical mode of life. What is less obvious is the equal importance of the delimitation of the requirements involved in these relations. It is necessary to determine the degree and the frequency with which individual host species are parasitized and to ascertain not merely how amenable they may seem to be as victims but how successful they are as fosterers. The results of such a survey should make it possible to deduce which factors tend to make certain species successful hosts from the standpoint of the parasite and others unsuccessful—or, to view it from the opposite side, which factors tend to protect certain potential hosts, and not others, from the attentions of the parasite.

Inasmuch as the cowbirds are altricial birds—hatched naked, blind, and helpless—they could not succeed with precocial birds as hosts—which are hatched down-covered, seeing, and active—as I stressed in my first (1929, pp. 189–190) description of the situation. At that time I listed three other requirements in addition to the need for an altricial host: the host species should lay eggs that are not much larger, if at all, than those of the cowbird; its manner of feeding its young should not depart greatly from the normal passerine method; and it should feed its young on more or less typical passerine food—insects, worms, soft seeds.

The cowbirds are not specialized for a parasitic existence in the sense that some cuckoos and honey-guides are. They have no adaptive structures, functional gradients, or innate reactions that may be looked upon as oriented especially toward survival at the expense of their nest-mates. While more often than not the nestling cowbird is larger than its nest-mates, which gives it an advantage in competing

with them, it is not unduly rapid in its growth or especially aggressive towards its food rivals in the nest. As Nice (1932, p. 47) has put it in the case of the brown-headed cowbird, the nestling cowbird "does not grow faster than its nest-mates purely through greed; it has to make nearly twice as big a bird in the same short space of nine or ten days." While the young cowbird is frequently found to become the sole occupant of the nest, this is not because it evicts its nest mates the way some cuckoos do. The expired, unsuccessful competitors for food are removed by the adult hosts, not by the young parasite.

The range of host selection by the parasitic cowbirds reveals two trends. The most primitive of the parasitic species, the screaming cowbird, *Molothrus rufo-axillaris*, is parasitic wholly on the very closely related and ancestral form, the non-parasitic bay-winged cowbird, *M. badius*. Both are very late breeders in the Argentine summer, chiefly from January to March, and the mere circumstance that other small passerine birds have finished nesting by then may be the factor which helps to maintain such a stringent, seemingly obligate, host specificity. From this basic, exclusive selection two trends branch out.

One, developing through the shiny cowbird, *M. bonariensis*, and the brown-headed cowbird, *M. ater*, is characterized by extremely wide host selection, the known victims including small passerine birds of all sorts and families, ecologically and geographically sympatric with the parasite. As might be expected in parasites with broad host tolerance, not a few unsuitable and improbable species of birds have been utilized by them, but such instances are no more meaningful than casual or accidental occurrences are in plotting the normal inclusions of a local fauna.

The second trend is toward a more restricted host selection, although not nearly as much as that in the screaming cowbird. Here again, two species of parasites are included, the bronzed cowbird, *Tangavius aneus*, and the giant cowbird, *Psomocolax oryzivorus*, both of which tend largely to utilize nests of related icterine species. In the case of the bronzed cowbird, about half of all the recorded instances of its parasitism involve hangnests of the genus *Icterus*, but the other half shows that the species has extended its range of hosts to include numerous other birds as well, some of them frequently. Its host catalog includes 52 species in all, of which 11 are species of *Icterus*. The giant cowbird, less well observed and less perfectly known than the bronzed, is known to restrict its choice of brood victims to larger birds of the oropendola-cacique portion of the Icteridae, but there is a record on one occassion of its parasitizing a jay.

On the whole, the survey of the host relations of all the cowbirds reveals that the hosts have exerted a surprising lack of selective effect on the development of the cowbird's brood parasitism. It is true

that, while the cowbirds do have host species which are most frequently used by them, the parasites show little tendency to ignore other potential victims. On the other hand, a small but appreciable number of hosts responds adversely to the intrusions of the parasite, although not to a degree that has become critical in an evolutionary sense. Even here, the adverse responses (which constitute desertion of the nest, covering over the parasitic egg with a new nest floor, or actually throwing out the intruder) are not behavior patterns that appear to have been developed as defenses against parasitism. These responses are not specifically "anti-cowbird" in their organization but rather are generalized types of reaction to something foreign entering the nest. As far as I know, no bird has actually developed a special defense against parasitism. In fact, it is difficult to imagine a clearly defined defense against an unspecialized parasite. In most cases, the normal fecundity of the host species enables it to survive the inroads of the parasite.

There is no evidence which suggests the existence in any of the cowbirds of what have been called gentes in some species of parasitic cuckoos—infraspecific units intermediate in nature between true polymorphic types and the more usual, geographically delimited, subspecies. The chief, indeed the only visible, characters of these gentes are the color and pattern of their egg shells and the corresponding degree to which they resemble the eggs of their usual hosts. As Southern (1954, p. 220) has rightly concluded, if this egg mimicry has evolved from an originally wide range of variations under the operation of natural selection, the most probable selective agent must have been, and still is, the discrimination shown by the fosterers. It follows that such adaptive evolution could only have taken place with parasites with a marked tendency to individual host specificity, and, for the existence of such traits in some of the species of *Cuculus*, there is good supporting evidence. In the brown-headed and in the shiny cowbirds, however, the evidence (see pp. 14-15) is sporadic in nature and gives the general impression that individual host specificity is the exception rather than the rule, although such cases may be expected to increase in number as field studies become more critical and more intensive.

Furthermore, if we tabulate the frequency of nest desertion after parasitism by the cowbirds, and then compare the dissimilarity (to human eyes) of the eggs of the deserting hosts and those of the parasites, we find no correlation. The most frequent deserters among North American victims of the brown-headed cowbird, such as the yellow-breasted chat and the cardinal, lay eggs quite similar to those of the parasite. Desertion seems due more to "nervousness" about alien interference with the nest than to any obvious incon-

gruities in the eggs themselves. Similarly, many hosts which regularly accept and incubate the parasitic eggs lay eggs readily distinguishable in size and coloration from those of the cowbird. Examples, to note but a few, are the eastern phoebe, red-eyed vireo, and chipping sparrow.

While the brown-headed and the shiny cowbird parasitize birds of a considerable range in size (from *Polioptila* and *Empidonax* to *Toxostoma* in the case of the former species; from *Myiophobus* and *Sporophila* to *Mimus* in the latter), the parasites do not lay noticeably small eggs for birds their size, as do some species of *Cuculus*. There has been no evolution in size or in coloration tending to make cowbird eggs more readily acceptable to their hosts, as we find in some cuckoos.

The data presented in this report on the several hundred species of hosts of the various cowbirds are not only of interest from the standpoint of the habits of the parasites, but also serve as a digest of all that is known of this aspect of the natural economy of each of the victimized species. In not a few instances, the parasitism of the cowbirds forms an important element in the breeding success rate, and hence, in the population dynamics of the host.

Brown-headed Cowbird

Molothrus ater (Boddaert)

Discussion

There are several reasons at the present time for presenting a new and comprehensive host catalog for this species. The amount of information brought together here is much greater than what was available at the time of my earlier (1929) account: thousands of additional instances of cowbird parasitism have been noted and correlated with the thousands of cases previously reported. Moreover, the additional information pertinent to, or even tangential to, the problem, as well as the actual discrete bits of new data on many of the previously included species, permits much more satisfactory analysis and interpretation than formerly were possible.

The rise in the number of known hosts is due to several factors. For one, the brown-headed cowbird has increased its range and its numbers in some areas, such as parts of the Gulf and southern Atlantic states, California, and parts of Canada. In Alabama, for example, Imhof (in litt., 1960) informed me that it now breeds throughout the state, whereas only 10 years earlier its range was restricted largely to the coastal belt. Monroe (1957) produced evidence that the bird was breeding in Florida. Webb and Witherbee (1960) have collected and summarized data establishing the extension of its breeding range across the western half of Georgia, as well as into northwestern and northern Florida. Grinnell and Miller (1944, p. 437) noted that the bird had "increased phenomenally in southwestern California since about 1915, in the San Francisco Bay region since about 1922, and in the Sacramento Valley since 1927, if not earlier . . . ." In Ontario, Snyder (1957, p. 35) concluded that "unquestionably the species has moved northward 200 miles or more during the present century." Such geographic expansions have brought the parasite into contact with additional potential victims. Furthermore, since the number of observers has increased greatly in the older ranges of the bird, many additional data have been placed on record—this in spite of the decline of egg collecting, which was once the primary source of information. Still another factor in the increase of the host list is the great change in our understanding of the specific and subspecific status of many of the birds involved.

Although I have brought out a number of supplements since my

1929 list (1931, 1934, 1938, 1943, 1949), it has become exceedingly difficult to present the data for the use of the reader who does not have the time or facilities to correlate the various records. This is due largely to the many changes in nomenclature that have been introduced into the literature. Two completely revised editions (1931 and 1957) of the official check-list of North American birds have been published by the American Ornithologists' Union since my first catalog. Many additional races of birds have been recognized, a fact which has necessitated critical reallocations of many hundreds of the older records, and in some instances forms that were previously considered species are now united as conspecific races. In the present catalog I have adhered strictly to the last (fifth) edition of the check-list and have not included any deviations from it no matter how justifiable they may have seemed. Over the years many students have written me about birds they were studying, as they found it difficult to put together the pertinent cowbird data for these particular host species. This has been especially the case with individuals contributing life history accounts to the series of Bent volumes, and this continuing source of inquiries, together with other queries, as I stated in the preface, has led me to think that a need existed for the present catalog.

In the annotated catalog of hosts of the brown-headed cowbird the species is taken as a unit and is discussed as such, although reference is made to the race or races involved in each case. To make the total mass of records immediately available to investigators interested in a particular race of either the host or the parasite, a complete tabular summary precedes the catalog. Inasmuch as the racial differentiations of the various host species occur along many different geographic patterns, frequently quite dissimilar to that of the parasite, it follows that a single race of a given species of victim may be imposed upon by more than one race of the parasite, and also that several races of a species of host may be parasitized by the same race of the cowbird. The tabulation (pp. 41-44) reveals that the eastern race, *ater*, of the cowbird is known to have parasitized 138 species (174 species and subspecies) of birds; the northwestern race, *artemisiae*, to have affected 101 species (139 species and subspecies) of birds, and the small southwestern race, *obscurus*, to have victimized 86 species (122 species and subspecies) of birds. The total for the brown-headed cowbird, as a species, is 206 species (333 species and subspecies) of victims.

Frequency of Host Selection

Of the total number of birds included in the present catalog, more than half are uncommon, rare, or even accidental victims. No

fewer than 42 species have been reported but a single time as hosts. Another slightly larger group have been noted more than once but not more than five times apiece. In my extensive compilation of data, I find only 17 species have been recorded as cowbird victims 100 times or more; these must be looked upon as the chief fosterers although at times, and in some localities, still other species may be found to be as important, if not more so, to the parasite. In descending order of frequency of parasitism, these 17 are: yellow warbler and song sparrow, with about 1,000 instances each; red-eyed vireo, 875+; chipping sparrow, 650+; eastern phoebe, 375; rufous-sided towhee, 300; ovenbird, 280+; yellowthroat, 250+; American redstart and indigo bunting, with about 200 records each; yellow-breasted chat and red-winged blackbird, about 180 each; Kentucky warbler, 150; Traill's flycatcher, 150; Bell's and yellow-throated vireo, and field sparrow, with approximately 100 to 125 records each.

The next group of frequently imposed upon victims comprises some 17 species, for each of which there are on record more than 50 but less than 100 instances. In descending order of frequency these are: veery and Kirtland's warbler, with about 80 records each; wood thrush, chestnut-sided warbler, and Louisiana waterthrush, with about 75 apiece; cardinal and vesper sparrow, with about 70 each; warbling vireo and myrtle warbler, with over 60 each; eastern wood pewee, prothonotary warbler, scarlet tanager, painted bunting, dickcissel, American goldfinch, clay-colored and swamp sparrow, with over 50 instances each.

Of lesser frequency, but still important as cowbird hosts, are the following birds, for each of which between 25 and 50 records are available. Listed in descending order of frequency they are: rose-breasted grosbeak, with 40 instances; Acadian flycatcher, white-eyed vireo, black-and-white warbler, worm-eating warbler, blue-winged warbler, and white-throated sparrow, with 34 to 40 apiece; eastern bluebird, prairie warbler, blue grosbeak, and lark sparrow, with over 30 apiece; and catbird, brown thrasher, hermit thrush, blue-gray gnatcatcher, and savannah sparrow, with 25 to 30 records each.

These 50 hosts account for approximately 7,800 records out of a total of about 9,000 instances of cowbird parasitism. It would seem that the proportionate role they play in nature is, if anything, even greater than these figures would suggest, since many instances of parasitism upon common hosts are left unrecorded because of their repetitive nature, while most cases involving uncommon victims are published as records of particular interest.

In much of the literature one finds statements to the effect that certain species are "commonly," "frequently," or even "invariably" parasitized. Such statements of course cannot be translated quanti-

tatively into the figures here presented, but they do establish that the actual listed instances form only a portion of the total experience of all the observers. In my first compilation (1929) I did attempt to estimate them and added the resultant figures to the records, but they are not included in our present totals as there is now enough data to be able to afford to disregard the earlier estimates.

Aside from the frequency with which they are parasitized, some host species are important to the brown-headed cowbird in terms of their unusually extensive geographic ranges, as contrasted to some others that are much imposed upon in relatively limited areas. The common hosts of great geographic availability to the parasite are, in descending order of importance: song sparrow, yellow warbler, red-eyed vireo, chipping sparrow, rufous-sided towhee, yellowthroat, yellow-throated vireo, yellow-breasted chat, redwinged blackbird, warbling vireo, American goldfinch, and lark sparrow. Even among these, there are geographical and ecological differences; for example, in the eastern areas, where it nests chiefly in cattail swamps, the redwinged blackbird is seldom molested, whereas in other areas in which it nests in bushes, it is a frequent host, and, in an over-all picture, by virtue of its abundance over a vast range, it has been reported as a host a great many times. Similarly, the American goldfinch, while available geographically, is often unavailable seasonally since it is a late nester. The prime example of an extremely localized, but locally very important, host, is Kirtland's warbler; the golden-cheeked warbler is another case, but it appears to be less intensively parasitized.

Inasmuch as data are still relatively sparse and incomplete south of the Mexican border, the following breakdown of the cowbird's hosts is restricted to the area covered by the official checklist of North American birds, comprising the United States and Canada and including Baja California but not the Mexican mainland. In North America the bulk of the cowbird's victims are found in eight families—the tyrant flycatchers, the thrashers and their allies, the thrushes, the vireos, the wood warblers, the orioles and blackbirds, the tanagers, and the finches.

Of the 32 species of flycatchers in North America, 17 are known to be parasitized. Of the remaining 15, about half do not nest within the breeding range of the parasite, or they are birds whose nests seldom have been observed, or they are hole-nesters and are thereby relatively immune to the attentions of the cowbird. Two flycatchers, the eastern phoebe, and Traill's flycatcher, are important, frequent hosts.

The thrashers are somewhat infrequently imposed upon, but 7 of the 10 North American species have been found to be so affected;

however, the catbird and the brown thrasher are the only species for which there are numerous records.

Of the 18 North American members of the thrush family, 8 are known to be parasitized; 6 of the others do not breed in the cowbird's range. Some of the brown thrushes (*Hylocichla*) are important hosts.

The vireos are severely parasitized. There are 12 species in North America, one of which, the black-whiskered vireo, is allopatric with the cowbird, but all the others are imposed upon, many of them extensively.

The near relatives of the vireos, the wood warblers, are also very important as hosts and include some of the most frequently victimized birds. There are records of parasitism on 45 of the 57 species of wood warblers in North America, and of the unused minority, about half are protected by their geographic or ecologic allopatry with the parasite.

The blackbirds and orioles of North America comprise 18 species, not counting the 2 species of cowbirds, and of these 18, 13 are included among the victims of the brown-headed cowbird. The redwinged blackbird is the only member of the family that is generally and frequently parasitized; some of the others are local in their sympatry and availability.

The tanagers are a small group in North America, comprising only four species, of which three are known to be victimized by the parasite.

The largest avian family in North America, the finches and their allies, comprises 84 species, of which 56 are known to be parasitized, including a good number that are used extensively. Of the remaining 28 species, 5 are only accidental in North America, not counted as breeding birds, and 16 others are allopatric with the cowbird. It is possible that, as the range of the parasite expands, some of these may become sympatric and may then be imposed upon. The northwestern extension of the cowbird's breeding range in British Columbia has resulted recently in the addition of the redpoll to the list of its victims.

In their comprehensive summary of the birds of Maryland and the District of Columbia, a very well-studied area, Stewart and Robbins (1958, p. 329) noted 223 cases of cowbird parasitism. Of these, 74 involved species of finches, 53 were with warblers, 44 with vireos, 12 with thrushes, 10 with blackbirds and orioles, 10 with flycatchers, 8 with tanagers, and 12 with various other hosts.

Changes in Host Selection

Comparison of the host preferences of *Molothrus ater* with those of its neotropical relative, *M. bonariensis*, shows some interesting differ-

ences. The latter bird parasitizes species of the following families, arranged in descending order of number of included host species: finches and their allies, 41 species; tyrant flycatchers, 27; blackbirds and orioles, 24; tanagers, 10; wrens, 7; and mockingbirds, 6. It also uses wrens and mockingbirds much more frequently than does *M. ater*. A number of purely neotropical families, absent from North America, such as ant-thrushes, spinetails, woodhewers, cotingas, and honeycreepers, are affected to some extent, but the real difference between the two cowbirds is found in their relation to the vireos and the wood warblers.

The South American *M. bonariensis* seldom uses nests of vireos and wood warblers, two families that are heavily parasitized by *M. ater*. It is not altogether valid to compare data on the two since the picture is about as incomplete in South America as it is complete in North America, but it may be noted that only 2 species of vireos and 2 of wood warblers are known to act as hosts for the shiny cowbird despite the fact that there are resident in South America some 18 species of the former family and 30 of the latter. (Figures compiled from Hellmayr's Catalogue of the Birds of the Americas.) To emphasize the difference involved here, one should recall that *M. ater* has been found to affect every North American species of vireo (11 in all) that breeds within its range. Moreover, the brown-headed cowbird is recorded as parasitizing 45 of the 50 North American species of wood warblers that are sympatric with it.

The shiny and the brown-headed cowbirds are similar in their frequent use of fringillids as hosts. In this family *M. ater* is known to impose upon 56 of the 63 species that breed sympatrically with it in North America. *M. bonariensis* is recorded as victimizing 41 of the 181 fringillid species listed by Hellmayr as breeding in South America. The figure 181 probably includes some species allopatric to the parasite, but the present state of knowledge makes it difficult, if not impossible, to determine this in many individual cases. This statement possibly applies also, and to a lesser degree, to the vireos and warblers discussed above.

Since the brown-headed cowbird appears to be a more recent evolutionary entity than the shiny cowbird, the differences between the two in host selection should be examined more closely. As pointed out in the discussion (pp. 192 ff.), the shiny cowbird's interest in domed nests has some of the attributes of atavism, a lingering of past stages in the history of that species; conversely, it is in keeping with the newer, if not necessarily more advanced, status of the brown-headed cowbird that this bird evinces much less tendency to enter and parasitize nests with dark interiors, such as domed structures or holes in trees. This could account for the fact that the North Ameri-

can bird seldom uses wrens as fosterers, but it does not explain the marked diminution of interest *M. ater* shows in the open and readily available nests of mockingbirds. The latter difference between the two species of cowbirds—and it is a marked difference—still remains a puzzling change in host selection.

Throughout its enormous range, the brown-headed cowbird has shown very slight alterations in its major host relations. Expanding into additional breeding areas, it has necessarily come into contact with, and made use of, host species not previously available to it, such as Kirtland's warbler in the jack-pine areas of northern Michigan, and the redpoll in northern British Columbia. In other areas of recent occupancy there is some evidence that suggests *M. ater* has made more frequent use of certain fosterers than it regularly does in areas of older cowbird equilibrium. An example is the blue grosbeak in southern California (p. 139). In all these instances, however, no obvious change in the general pattern of habits is involved. In all cases the hosts are fairly similar to other, previous hosts in their nest construction and in their main ecological choice of nesting sites. When a wide-ranging host shows a marked ecological difference in various parts of its range, its status as a cowbird victim may change accordingly. Perhaps the best example of this is the redwinged blackbird. In the eastern portions of its range it nests almost entirely in the cattail swamps, where it is rarely molested by the parasite. Elsewhere it builds its nests frequently in bushes, and there it is commonly parasitized.

The broad spectrum of host choice and the general lack of specialization within this wide latitude seem to have made it unnecessary for the parasite to develop any strikingly differential host relationships. That some such may be formed eventually is suggested by the data presented in our discussion of the prothonotary warbler, a hole-nesting bird for which a surprisingly high frequency of parasitism has been recorded in the vicinity of Burlington, Iowa (see p. 92).

While our present knowledge of the wide-ranging shiny cowbird is much less complete than is that of the brown-headed species, the former does offer some evidence which is suggestive of geographical changes in host selection. For example, the wren, *Troglodytes musculus*, is parasitized in Argentina, but not nearly as frequently as are some sparrows, mockingbirds, and flycatchers, whereas in Surinam and adjacent areas it appears to be the chief fosterer. In Chile, where the shiny cowbird may be a fairly recent intruder, the primary host is the diuca finch, *Diuca diuca*, although the chingolo, *Zonotrichia capensis*, by far the most frequent victim in Argentina, Uruguay, and Brazil, occurs in Chile as well and is not disregarded completely by the Chilean cowbirds.

One cannot avoid the general conclusion that the brown-headed cowbird, biologically a very successful species, both in terms of its great population numbers and of its wide geographic range, is a success by virtue of its lack of specialization. This success may be due to the fact that throughout its range there are no discontinuities of any significance; consequently, no opportunities are present for locally restricted and inbred groups to express themselves in differential host preferences. In terms of host relationships the brown-headed cowbird seems to bear out Mayr's (1954, p. 178) statement on morphological changes: "Successful species are usually widespread and rich in genetic variability, but they tend to be rather conservative from the evolutionary point of view. . . ."

Intensity of Parasitism of Frequent Hosts

Of all the parasitized nests recorded with full data as to the number of eggs present, approximately 60 percent contained but a single cowbird egg apiece; in many of the others, however, 2, and less frequently 3, or even more, of the parasitic eggs were present. These figures are composites, based on all available records, but if we restrict our considerations to the more recent, more carefully made studies, the data from which were recorded in greater detail, we find actually the opposite phenomenon—a slightly greater number of nests with multiple cowbird eggs than with single ones. Including even the old "scattering" records made largely by unsystematic egg collectors and not by careful students of the birds concerned, we find, for example, in the case of one host, the Louisiana waterthrush, that multiple cowbird eggs were discovered more frequently than single ones. Of 55 parasitized nests, 25 held 1 cowbird egg apiece, 20 had 2, 7 had 3, and 3 had 4.

For an example of results from newer, more fully investigated and more completely documented source materials, we may note that in Hofslund's study of the yellowthroat (discussed on pp. 118–119 of the present report) about three-quarters of the parasitized nests contained more than one cowbird egg apiece. While this condition is true in the area he studied, it is not certain that a similar degree of parasitism is general throughout the range of the yellowthroat.

In 1960 Ussher found an unusual situation in the nest of a wood thrush in Rondeau Provincial Park, Ontario; this nest contained a single egg of the thrush and 12 of the brown-headed cowbird. I was informed by W. P. Nickell that the park area had been sprayed earlier with DDT, which greatly decreased the population of nesting birds, thereby reducing the number of nests available for the cowbirds. This may have been a cause behind the excessive use by the cowbirds of this particular nest. A similar conclusion was expressed by Hann

(1941, p. 220) in his study of the ovenbird, wherein he found that the cowbird usually laid but one egg in a nest "unless nests are scarce; in that case she lays more. . . ."

As a matter of record, it may be noted that as many as 9 cowbird eggs have been reported from another nest of a wood thrush by Hofslund (1950) in Minnesota, where apparently no DDT spraying had been done. As many as 8 have been recorded from single nests of the black-and-white warbler, the veery, the rufous-sided towhee (several such instances, ranging from 1 to 5 of the hosts' eggs), and the ovenbird. Seven cowbird eggs have been found in one nest of a red-eyed vireo, in one of a scarlet tanager, and in one of a song sparrow. Six cowbird eggs were recorded from individual nests of a yellow-breasted chat and of a yellow-headed blackbird, and 5 from single nests of the scarlet tanager, the indigo bunting, and the veery. Berger (1955, p. 84) described a six-storied nest of the yellow warbler with a total of 11 cowbird eggs in its various levels.

The number of parasitic eggs that may be accepted by a host ordinarily appears to be limited to not more than its own maximum clutch number. In the case of many of the smaller hosts, however, such a number of cowbird eggs would overcrowd the nest to the point of physical discomfort to the covering bird and might lead to desertion. In these cases a smaller number seems to be the effective limit. What we are concerned with at this point is merely the acceptance of the egg situation, quite apart from the very different question of the host's ability to hatch and rear this number of young cowbirds. Current understanding and information suggest that what we have here is not a matter of latent counting ability in the hosts, enabling them to sense a "correct" number of eggs in the nest, but more probably a reaction to the visible proportion of the combined mass of eggs to the available space in the nest, or even the amount of surface stimulation the eggs of a given clutch size produce on the brooding surfaces of the body of the host birds.

Furthermore, as indicated by Tinbergen (1951, p. 45; 1954, pp. 246–247) it is conceivable that additional eggs or larger eggs, such as often result in a parasitized nest, may actually enhance the released incubatory response of some birds. For example, he mentions that, when given the choice in experimental cases, oyster-catchers seem to prefer clutches of one or two eggs above their usual clutch number and to prefer eggs of double, or even more than double, the size of their own. I am not aware that similar reactions have been tested critically in small passerines, but if they were found to behave in similar fashion, it might help to explain some of their otherwise surprising acceptances of parasitism.

While it is true that cowbird eggs show no tendency toward adaptive resemblance to those of their frequent hosts, the fact that such similarities have been evolved in some of the Old World cuckoos suggests that there may be, and often probably is, an advantage to the parasite if its eggs are not too readily distinguishable by the hosts from their own. However, that such similarity is not always essential is amply shown by the success of the cowbirds.

In some cases, more than one egg is laid in the nest by the same hen cowbird, as Savary (1936) discussed in his account of Bell's vireo; in others, more than a single bird is responsible. Byers (1950, p. 136–138) judged from the differences in size and coloration of the 8 cowbird eggs he found in one nest of a black-and-white warbler, that four female cowbirds had been involved, and Mulliken (1899) concluded that five different birds had laid one egg each in a scarlet tanager's nest that he described.

At Nickelsville, Virginia, F. M. Jones (1941, pp. 117–119) had the opportunity to study the egg-laying of a female cowbird which laid a very distinctively colored, hence easily recognized, egg. He found a total of 8 eggs from this bird between May 5 and June 15 in eight nests of four different species—two white-eyed vireos, three prairie warblers, two field sparrows, and one summer tanager. In my own field studies (Friedmann, 1929, p. 183) I found that one hen cowbird had laid 5 eggs in four nests of the veery, the chestnut-sided warbler, and the redstart. Another individual had laid 2 eggs in a redstart's nest, and 3 in one nest of a red-eyed vireo; still another bird had laid 4 eggs in nests of the veery, the red-eyed vireo, and the redstart. These cases indicate that ordinarily the parasite is not individually host-specific. Yet there are some data that suggest that at times and in particular situations some hen cowbirds may show incipient, if not developed, specificity in their choice of victims.

Such a case is described in our account of the prothonotary warbler (see pp. 91–92). At Burlington, Iowa, J. P. Norris (1890, pp. 177–182) found 35 nests of this warbler within a period of two weeks, and of these, 18 contained 1 or more cowbird eggs. Since this warbler nests in holes in trees and since the cowbird ordinarily shows little interest in nests in such a concealed situation, it appears that some individual hens at Burlington must have had an appreciably consistent tendency to choose the prothonotary warbler as a host. Another, and in some ways even more striking, example is Walkinshaw's series of observations on a cowbird consistently parasitic on a field sparrow in Michigan (see pp. 164–165).

Further evidence of host-specific tendencies was found by Dr. and Mrs. D. McGeen, who very kindly sent me a summary of the results of their intensive study of the cowbirds and their hosts near

Otter Lake, west of Pontiac, Michigan. They followed very closely the breeding activities of several female cowbirds, each of which was readily distinguishable by the consistent size and coloration characteristics of its eggs. One of these laid 18 eggs, all in nests (18 in number) of the yellow warbler. Another cowbird was responsible for 6 eggs from May 18 to May 27, also all in yellow warbler nests; a third individual laid 6 eggs between May 18 and 28, 5 of which were deposited in as many nests of yellow warblers and one in a song sparrow nest. On the other hand, another cowbird laid 19 eggs between May 9 and June 19, using as its depositories 11 song sparrow, 6 yellow warbler, and 2 Traill's flycatcher nests.

Breeding Success of Host and Parasite

Whether the same cowbird scatters her eggs in different nests or tends to deposit more than one in the same nest, the resulting frequency and degree of parasitism makes one ask what the damage is to the hosts and how they are able to stand up under it. In many accounts, the impression is that the imposition on the host is excessive, and yet the situation continues year after year. In only one species, the Kirtland warbler (see pp. 108–111), however, does the situation become alarming for the continued welfare of the host.

In attempting to estimate the effect of cowbird parasitism upon the most frequently used, or at least the most often reported, host species, we may take as a basis for our discussion the data compiled by Nice (1957, pp. 317–318) on altricial birds. The success rate of open nests of altricial birds in the north temperate zone, as recorded in 24 studies on 7,778 nests, ranged from as little as 38 percent to as much as 77 percent, with an average of 49 percent. In 29 studies, involving a total of 21,951 eggs, fledging success (that is, success to the point of resulting young developed to the stage wherein they leave the nest) ranged from 22 percent to 70 percent, with an average of 46 percent. Possibly because of the lesser exposure to predators, hole-nesting species averaged a higher degree of success; 33 studies involving 94,400 eggs showed fledging success of from 26 to 94 percent, with an average of 66 percent. Lack (1954, p. 87) gave almost the same percentages.

Although they are included in the above summaries by Nice, it is of interest to review the breakdown by species given in Kendeigh's paper (1942, pp. 19–26). He studied the outcome of 2,725 nesting attempts by 51 species, mostly of forest-edge passerine birds, in the central United States. Considering only species for which he had 7 or more nest records, the percentage of nesting successes was 80 to 90 percent in the Baltimore oriole, barn swallow, house wren, and cardinal; 70 to 80 percent in the starling, flicker, phoebe, and purple martin; 60 to 70 percent in the catbird, yellow warbler, song sparrow,

wood thrush, and red-eyed vireo; 50 to 60 percent in the chimney swift, bluebird, chipping sparrow, brown thrasher, field sparrow, and goldfinch; 40 to 50 percent in the mourning dove, black-capped chickadee, cedar waxwing, and crested flycatcher; and less than 40 percent in the house sparrow.

While no percentages based on such ample data are available for the brown-headed cowbird, it may be noted that Norris (1947) reported on 237 nests of various passerine host species at Preston Firth, Pennsylvania. In these nests the hosts laid a total of 668 eggs, of which 383, or 57.3 percent, hatched; cowbirds laid 108 eggs, of which 46, or 42.6 percent, hatched. The fledging success was 37.7 percent for the eggs of the various hosts, and 26.8 percent for those of the cowbird. Of the host eggs that hatched, 64 percent produced fledglings; of the cowbird eggs that hatched, 63 percent produced fledglings. All but 4 of the parasitized nests that produced fledglings produced at least one host fledgling. The 35 successful non-parasitized nests produced 2.94 fledglings per nest; 19 successful parasitized nests produced 2.05 host fledglings per nest—from which it follows that each young cowbird was raised at the expense of approximately one host young. These figures agree very closely with those given by Nice (1937, p. 200) for cowbird parasitism on the song sparrow (see p. 170).

Another study, on a smaller scale, by Betts (1958, p. 143), of the passerine birds on a farm in southern Michigan, revealed that, of 39 cowbird eggs laid in 34 nests of 12 species of open-nesting hosts, 20 hatched and 14 survived to leave the nest—a fledging success of about 36 percent. However, this is about three times the fledging success of cowbirds in ovenbirds' nests, mentioned below (pp. 112–113), and this, in turn, is better than the fledging success of cowbirds in nests of yellow-throats studied by Hofslund (see below, and pp. 118–119).

On the other hand, the rate of cowbird success is higher in the case of larger, less susceptible hosts. For example, Nice's data on the song sparrow showed that 30.7 percent of the cowbird eggs survived to the fledging stage, as compared with 35.8 percent of the song sparrow eggs.

In other words, the general breeding success of the cowbird, like that of so many other parasitic animals, is often much lower than that of its chief victims. This is the saving factor in the picture. It helps to allow for the survival of the host population in sufficient numbers for its continuing availability and usefulness to the parasite, even though at times this seems to be made difficult by the very degree to which the hosts are successful as fosterers. If the common hosts were to suffer too drastically in a numerical sense from the parasitism of the cowbird, there would result a scarcity of hosts, which in turn would cause a diminution in the possible number of

young cowbirds reared. But this, again, might give the fosterers the opportunity to increase—and so on, in endless waves of depletion and increase of the population, both of the parasite and of its usual victims.

The natural fecundity of almost all the frequent hosts is sufficient to stand the losses due to cowbird parasitism. The idea that the two factors are necessarily mutually counteracting forces involved in maintaining or upsetting the so-called "balance of nature" is suppositious. What we may have here is another, if somewhat special, type of predator-prey relationship. In a study, of which only a summary has been published, Darling (1959, pp. 62–63) minimized the supposed importance of predation in maintaining the "balance of nature." He pointed out that recent, critical, analytical studies have indicated that predation is, in itself, quite unimportant as a factor in regulating the size of the populations of the prey species and that the latter are, to a large degree, self-regulating. He suggested that the effects of predation—and it seems that brood parasitism may be looked upon as a form of predation on the next generation (the eggs), if not the present one (the adults), of the prey species—will be found to vary with the degree to which the population of the prey species is experiencing "optimal conditions in its ecological niche. The complex of predation may be important in conservation of habitat and consequently of the prey, by softening zenith and nadir of population oscillations and so lessening the percussive effects on habitat."

At a meeting of the American Ornithologists' Union at Ann Arbor, Michigan, in August, 1960, the McGeens reported on a study of the effect of parasitism by the brown-headed cowbird upon several of the more frequently chosen species of hosts. The McGeens correlated the incidence of parasitic successes and of host losses due to the parasite with the population density of the cowbird. In areas where the cowbird was more numerous, it was observed that not only were more nests victimized, but also that a larger proportion of these nests contained more than a single parasitic egg. To express the "cowbird pressure" as a factor in these correlations, the McGeens used the average of the percent of host nests parasitized and the percent of multiple cowbird eggs as compared with single ones in these nests. It was assumed, and correctly so, that even though it was not possible to find all the nests of a given host species in a study area, the sample observed, if not too small, should give a proper picture of the degree of parasitism suffered by that host.

The "pressure" which cowbirds exert was divided by the McGeens into two phases: the size of the affected segment of the entire nesting population of a given host (in other words, the percentage of its nests parasitized), and the degree or intensity of parasitism inflicted upon this segment. The reasoning was that a parasitized group

of nests, each containing a single cowbird egg, was under less "pressure" than a similar group with 2 or 3 cowbird eggs apiece. On this basis the McGeens concluded that these multiple eggs were a readily usable key to the pressure rate: the higher the proportion of multiple eggs to single ones in the total parasitized nests, the greater the cowbird pressure. By averaging these two parts of the picture, it was possible to arrive at a single "pressure index" for the whole host population in a study area, and this index could then be used in correlating parasite successes and host losses.

It seems to me, however, that multiple cowbird eggs, beyond a total of three, are almost always lost or wasted eggs. From this it follows that any cowbird "pressure" of more than 3 eggs in a nest may not have more effect on the host than does the "pressure" of just 3 eggs, a situation which, in itself, usually spells disaster to the entire nest contents. If the presence of 3 cowbird eggs in a nest is fatal to the outcome of the nest, 4 or 5 eggs cannot be more so. The only effect these extra eggs can have is that the parasite is literally expending its reproductive resources in the one way that cannot further harm its victims.

It may be explained, at this point, that whereas the McGeens appeared to be thinking of the cowbird "pressure" as a descriptive element in the demographic situation, the concept of "pressure," as I am using it here, applies directly to the degree to which, or the intensity with which, the host is caused to feel the effect of the population density of the parasite. This would account for the difference in the significance attached by them or by me to the matter of multiple eggs above three in a nest. The difference is important, but actually it applies only to a small percentage of the instances of parasitism because, in the great majority of cases, less than 3 cowbird eggs are involved.

One other thought may be introduced here. As Lack (1954b, p. 155) has expressed it in his study of the evolution of reproductive rates, the clutch size in nidicolous birds is limited by the number of young that the parents can feed. "With broods above normal size, fewer, not more, young are raised per brood. . . . The decline in fecundity with rising population density, found in both birds and invertebrates, is primarily a response to a dwindling food supply for the young, and not to population density as such. . . ."

Within the total range of resultant host-parasite relationships which emerge from the McGeens' study, at least two balanced situations, or balanced economies, were found to exist. Host species of small size or of relatively slow incubation and rate of nestling development were very susceptible to the presence of eggs or young of the parasite,

and a considerable percentage of these cases failed to come through to the fledging stage. They gave a low success to the parasite; consequently, they were rated as poor hosts from its standpoint. Examples include such frequent victims as Traill's flycatcher, Bell's vireo, the yellow warbler, and the field sparrow. Larger hosts, or hosts with more rapid growth gradients, proved less susceptible to the cowbirds and consequently resulted in a notably higher parasite success rate, even at higher pressures, and these the McGeens rated as good hosts. Examples of these included the song sparrow, the ovenbird, the yellowthroat, and the red-eyed vireo.

The importance that the relative size of the host species may have is shown in the case of two frequently parasitized species of vireos, the red-eyed and Bell's. The two are similar in their general nesting, egg-laying, incubation, and feeding habits, and yet Bell's vireo is a poor host, with a high frequency of loss to the parasite, while the red-eyed vireo is a good one. The latter is nearly half again as large as the former, which fact appears to be the chief determining factor in the red-eyed vireo's relations with the parasite. For a further analysis of what may be correlated with mere body size, see my discussion of the hatching potential of the host species (p. 21).

As is indicated in my account of Kirtland's warbler (pp. 108–111), based on Mayfield's detailed study, this host is an instance of an unbalanced economy, and it suffers perilously because of it. Here again the large size of the warbler—as large as, if not larger than, any of its congeners—makes it a good host to such a degree that it is in danger of depleting its own population in serving its parasite.

The frequency with which the brown-headed cowbird parasitizes some of the poor hosts is one of the main checks on its increase and spread, since a poor host is a major factor of loss for the parasite. The egg and nestling mortality are correspondingly higher than they would be if the cowbird restricted its attentions to potential fosterers capable of rearing its young with a higher rate of success.

In an evolutionary sense, this inefficient host range might conceivably be looked upon as an indication of the imperfection and even of the relative recency of the parasitic habit. If the degree of loss it causes the parasite were of critical importance, it might be expected that natural selection would tend to eliminate those individuals that laid their eggs more often in unpropitious nests. However, this would be possible only if there were a marked tendency for each parasitic hen to be more or less host specific. As we have already seen (pp. 14–15), the available evidence for actual or even incipient host specificity is hardly more than a number of isolated instances in a much larger mass of data, either quite devoid of any specificity

or positively opposed to it. It appears conceivable, however, that additional detailed (as opposed to relatively "loose") field studies may increase the evidence for host specificity.

One might speculate that the low survival rate between the egg stage of the cowbird and the fledging stage might be due to a selective mechanism which results in something partaking of the nature of differential reproduction. If this were the case, it could easily lead to a relatively rapid adaptive evolution of the parasite with respect to its frequent host relations. Something of this sort appears to have transpired in the case of the European cuckoo, *Cuculus canorus*, the Indian koel, *Eudynamis honorata*, and some other cuckoos, in which the degree of adaptive similarity in egg coloration achieved and the concomitant development of individual host specificity can hardly be explained on any other basis than the selective pressure brought to bear by the hosts. In the cowbirds, however, evolutionary changes in the parasitic habit, after its original appearance, seem to have been influenced surprisingly little by the hosts. The changes in the habit from the screaming cowbird through the shiny cowbird to the brown-headed species are chiefly a widening of the choice of hosts used, a trend towards egg removal, and, after a relatively high percentage of waste of eggs (in *M. bonariensis*), a more economical disposition of the eggs (in *M. ater*).

We may note at this point some of the better quantitative data available on a few of the frequently used host species. Since all of these are discussed in greater detail under each of the species in our catalog, only a brief statement is given here.

In the case of the song sparrow (see pp. 169–170), Nice (1937, p. 200) asked whether each cowbird raised was reared at the expense of a brood of sparrow young. The data showed that, while 66 successful unparasitized nests raised an average of 3.4 song sparrows each, 28 successful parasitized ones averaged 2.4 song sparrows. In other words, each young cowbird was reared at the expense of one young sparrow, not of a whole brood.

The red-eyed vireo (see pp. 87–89) was carefully studied by Southern in Michigan. He found 104 nests, of which 75 were parasitized. The nesting success of the vireo was 87.49 percent in unparasitized nests, 66.66 percent in parasitized ones. The last figure is not as different as one might have expected on the basis of Lawrence's study (1953) of this vireo in an area where there were no cowbirds and where the nesting success in 35 nests was 63 percent. Southern concluded that the local vireo population he studied did not suffer serious depletion even though it was heavily victimized. He considered the cowbird a necessary check on the undue increase of the vireo although he admitted that, if the parasite were equally successful with most

of its other hosts, it might become too numerous. He suspected, however, that the parasite has few other hosts with which it is equally successful.

Another frequently imposed upon victim is the ovenbird (see pp. 112–113). Hann (1937) estimated that 52 percent of all the active nests he watched were parasitized. The loss due to the cowbirds was 18 percent of the eggs and young of the ovenbird. The chief loss was due to the removal of eggs by the cowbird. Out of a total of 40 cowbird eggs, only 22 hatched and only 10 of these lived to the fledging stage, and not more than 5 survived to independence of their foster parents.

In the case of the yellowthroats (see pp. 118–119), studied by Hofslund over a period of four years, 152 eggs were laid in 52 nests, 20 of which were parasitized. Of the 152 eggs, 52 were lost; and of these, the loss of 30 seemed to be due to the cowbird. The 20 parasitized nests produced only 0.6 cowbird each; 9 of the 20 produced young cowbirds, or an average of 1.3 each.

As noted in my discussion of the field sparrow (p. 165), cowbird parasitism at times may reduce the percentage of nest-success for the host without producing any parasitic young.

With each of these host species, the survival rate of the cowbirds in their nests is relatively low. Even in species that seem to be overly burdened, the results are not especially disastrous as a rule. In the case of the Kirtland warbler (see pp. 108–111), however, the situation is otherwise. The survival rate of the cowbird with this host is high, about 41 percent, and approximately 55 percent of all Kirtland warbler nests are parasitized. It is estimated that the whole Kirtland warbler population would produce annually about 60 percent more fledglings of its own species if the cowbird menace were not present.

Hatching Potential of Host Species

Another factor that limits the degree to which a species can be a successful host to the parasite is what may be termed its hatching potential. A word of explanation may be in order, as the concept involved is seldom used in studies of wild birds. Incubation implies maintaining a fairly constant temperature in a clutch of eggs, the body of the incubating bird being the source of the heat. It implies the warming of the whole volume of each egg, not merely the portion that happens to be on top at any given moment of incubation. The amount of heat that the bird is able to give off is limited by its metabolism, which is, or more properly, is thought to be, fairly constant for each species. If a species usually lays 4 eggs of an average volume of, for example, 2 cc. each, incubation cannot succeed unless the bird

is able to produce heat sufficient to keep 8 cc. of eggs at a given temperature. The volume of an egg may be derived from its external shell measurements, according to a formula worked out by Schönwetter (1924). Using this method, the eggs of most vireos and small wood warblers (not the larger *Icteria* or *Seiurus*), some of the smaller buntings, and some flycatchers are found to have a volume of from 1.6 to 1.9 cc., while an average cowbird egg is just over 3 cc. Thus, the volume of a 4–egg set of a small warbler would be about 6.4 to 7.6 cc., or slightly to significantly more than that of 2 cowbird eggs. If the nest of a warbler were parasitized so that it held 3 warbler eggs and 1 cowbird egg, the clutch volume would be about 8 cc. If 2 of the warbler eggs were replaced by cowbird eggs, the resultant clutch volume would be 9.3 cc.; if 3 replacements were involved, the final egg volume would be 11 cc.

Hann (1947, p. 174) estimated that the ovenbird could incubate successfully an egg volume of between 1.3 and 1.8 times the volume of its usual laying of 5 eggs, and probably nearer the lower than the higher figure. Hofslund's (1957) observations indicated that 1.3 times the normal clutch volume was the limit that a yellowthroat could ordinarily incubate to successful hatching.

It follows that, while a host species such as the rufous-sided towhee, with eggs as large as, if not larger than, those of the cowbird, could incubate successfully 4 or even 5 of the parasitic eggs in place of its own, the smaller hosts could not. By and large, within passerine species, the hatching potential is correlated, with some exceptions, with the general size of the egg, which usually is related to the size of the bird.

Mutual Effect of Parasite and Host on Egg Production

The exact number of eggs produced in one season by one cowbird is still uncertain, and without this information it is difficult to estimate the overall percentage of egg success in the parasite to compare with that of each of the common hosts. In my own field studies (1929, p. 188) two cowbirds laid 5 eggs each and one laid 4, but it was not established whether these numbers represented a whole season's laying or merely the equivalent of a clutch, of which there might be more than one in a season. As a matter of fact, I quoted one instance of a cowbird in captivity reportedly laying 13 eggs in 14 days, a case that could not be checked for its accuracy. Nice (1937b, p. 164) concluded that the species laid three or four sets of up to 5 eggs per set, with an interval of from 6 to 12 days between sets. D. E. Davis (1942) rearranged the data and concluded that the interval between sets should be shorter, about three days. He also made sections of entire ovaries of several species of cowbirds (shiny, screaming, and bay-

winged) and found evidence for 5 eggs to a clutch (or set) for each but no histological evidence indicating whether there was but one clutch or several per season.

Jones (1941, pp. 117–119) studied one cowbird that laid a very distinctively colored egg, and he found 8 eggs, ostensibly of this one bird, from May 5 to June 15. How many others may have been laid by this hen and were not found by the observer cannot be stated.

As described in my account of the field sparrow (pp. 164–165), Walkinshaw (1949) reported that a single cowbird laid no less than 25 eggs between May 15 and July 20. Nice (1949, p. 233) showed that the dates in Walkinshaw's records suggested clutches of 5 eggs at daily intervals, with a break of several days between clutches.

That the individual cowbird studied by Walkinshaw was not as exceptional in its fecundity as it might seem is suggested by evidence sent me by Dr. and Mrs. Daniel McGeen, who found two cowbirds that had laid at least 18 and 19 eggs, respectively. The first bird laid its eggs in clutches of 3 (one each day from May 23 to 25, inclusive), of 7 (one each day from May 31 to June 6, inclusive), of 4 (one each day from June 9 to 12, inclusive), of 1 on June 18 (this is probably an incompletely recorded clutch that may have extended beyond June 18 by as many days as there were eggs laid), and of 3 (on June 27, July 1, and July 2). The other individual's 19 eggs similarly were grouped in "clutches."

In his general survey of the biology of avian populations and fecundity, Gibb (1961, p. 422) pointed out that the number of eggs laid by parasitic birds could be assumed to be governed, or at least limited, by the number of suitable nests in which to lay. This is an overly simplified statement inasmuch as there is evidence that parasitism at times may actually increase the number of nests provided by certain host species.

Thus, aside from providing evidence that a cowbird could produce as many as 25 eggs in one summer, Walkinshaw's data indicates a complicating factor which may well affect the total egg production of the parasite, which may well occur occasionally, and for which there is no adequate method of evaluation. He found that 25 eggs laid by one cowbird* were deposited chiefly in nests of one species, the field sparrow. These eggs were laid in 20 nests, 15 of which were deserted when the parasite laid an egg in them and removed a host's egg. A good many years earlier, Chance (1940) found that the European cuckoo, *Cuculus canorus*, could and did adjust the

* The evidence as to the identity of the parentage of all the eggs is as follows: all were found within a limited area; all were very similar in coloration, the length of 11 similarly colored eggs had significantly less variability than the length of 22 not similarly colored eggs; and no 2 of these eggs were laid on the same day.

number of eggs it laid to the opportunities presented in the favored hosts' nests which were in the proper stage of construction and receptivity. In commenting on Walkinshaw's data, Nice (1949, p. 233) pointed out that, since the particular field sparrows involved usually deserted their nests when parasitized, the continued attentions of the cowbird unwittingly may have caused the sparrows to build more nests—which, in turn, tended to increase the egg production of the parasite in a way quite comparable with what Chance achieved by manipulation of the available nest supply in the case of the European cuckoo. From a consideration of this cause-and-effect situation, Walkinshaw's data are not merely 20 more instances of cowbird parasitism on the field sparrow, each case no more significant than other random records, but they are a reflection of a local intensification of the host-parasite relations. Since there is no sure way of knowing how often and in how many host species similar situations may arise, it is impossible to allow for such situations with reasonable accuracy when quantitatively interpreting the total data for each species of common victim. It would follow that a host species, known to desert easily when parasitized, might thus inadvertently tend to increase the egg production of the parasite, provided that the latter persevered in using the same host species. Conversely, the effect of continued cowbird parasitism might serve thus to increase the nesting activities of the host. A comparable case (p. 171) is Berger's data on the song sparrow as a cowbird host.

This is actually and essentially the case in the numerous instances of multiple-storied nests of the yellow warbler, the lower stories of which each held buried cowbird eggs.

On the other hand, it must be kept in mind that, in the case of many of the single-brooded species of hosts, these birds may succeed in raising young of their own by renesting after the desertion or the destruction of the first parasitized nests. Parasitism may thus cause an extension of the hosts' breeding season. It follows that a mere calculation of the percentage of parasitized nests of these species gives only a partial picture of the situation. The critical point, namely the effect of parasitism on the total fledging success of the host species, is not accurately described by such percentage figures.

Cases of repetitive visits to the same host nest may be due to two factors. They may involve multiple hens of the parasite or they may be due to successive visitations of the same individual. The data essential for determining which may be the case are almost always left unrecorded, but the general question of continued attention to a host nest by an individual cowbird presents points worth considering, especially in connection with the problem of egg removal by the parasite.

Duration of Parasite's Interest in Host Nests

In his detailed study of the relations of Kirtland's warbler with the brown-headed cowbird, Mayfield (1960, pp. 144–181; 1961, p. 166) brought together evidence that the cowbirds involved had a continuing, almost proprietary, interest in the nests they parasitized. Individual females tended to return to the same nests, to remove eggs from them or to lay eggs in them, and did not molest other unparasitized nests indiscriminately. Mayfield found that the parasites did not remove eggs on the pre-dawn visits when they laid their own but did so several hours later, a day before, or, less often, a day later. The cowbird would not merely lay an egg and take one out; it would lay several and remove one; it would lay one and take several; but if there was only a single egg in the nest, the parasite would not remove it.

The interest in individual nests begins when the cowbird intently watches the nest construction by the warblers. This interest continues as the parasite inspects and looks into the nests at intervals. Later, as it repeatedly visits the nests to remove eggs from them, it shows its definitely localized concentration by the fact that it removes eggs only from nests it is using or is about to use, or that it removes only eggs of the host and not its own, or that it destroys several eggs at one visit to a crowded nest. In Mayfield's studies, the cowbirds were not banded or otherwise individualized, but his observations were close and careful, and they may be looked upon as an accurate indication of the actual state of affairs. He concluded that the cowbird has an impulse to lay an egg and an impulse to steal or remove an egg, and that it has a continuing and proprietary interest in the nests it uses.

Although evidence for similar continuing interest in host nests has not been recorded or documented from other portions of the brown-headed cowbird's range, one must admit that this may be a reflection of inadequate observation; the absence of such evidence does not prove the nonexistence of such continued attention. Something akin to Mayfield's experience seems to have been present in Hann's work (1941) with the cowbird and the ovenbird in Michigan. He noted that the female cowbird made regular trips of inspection to the nests during the absence of the owners, between the time she first discovered the nests and the time she laid eggs in them, and that she seemed to be aware in advance of ovulation where the egg was to be laid. Parasitized nests had one or more eggs of the ovenbird removed by the female parasite. The eggs were removed, not at the time of ovulation, but during the forenoon of the previous day, or the day of laying, or, more rarely, the following day. The cow-

bird has not been known to give any attention to parasitized nests after laying in them, other than to remove eggs from them. Ordinarily, eggs are not removed from nonparasitized nests.

However, whether the matter of continuing interest may be a general or an unusual situation, the concept of such durable attention has interesting phylogenetic aspects. We may recall that the nonparasitic bay-winged cowbird, *M. badius*, the most primitive of the existing cowbirds, usurps or adopts a nest of another bird, from which it then proceeds to evict any eggs or other contents, after which it goes on to use it as its own—a clear case of proprietary interest. It lays its eggs there and incubates, hatches, and rears its young in the acquired nest. The most primitive of the parasitic species, the screaming cowbird, *M. rufo-axillaris*, is parasitic on its close relative, the bay-wing, and in the parasitized nests of the latter, one finds multiple eggs of the former more often than single ones. Of 51 nests of the bay-wing found in Tucuman in northwestern Argentina by Pablo Girard, 46 were parasitized by the screaming cowbird. Out of these 46 cases, 6 nests contained 1 egg each of the screaming cowbird, 19 contained 2, 10 held 3, 5 had 4, 4 had 5, and 1 nest held 6 screaming cowbird eggs. While these multiple eggs suggest repetitive visits by their depositors, it must be admitted that no evidence was presented as to whether one or several *M. rufo-axillaris* hens were involved in the various cases. However, my own observations in the same general area indicated that the screaming cowbird was less numerous than the bay-wing, which would suggest (but only suggest) that these multiple eggs may well have been the result of successive visits of the same hen, at least in many cases. Successive visits is essentially what Mayfield referred to as continuing or even proprietary interest.

In my account (1929, pp. 48–49) of the screaming cowbird, which, unfortunately, no one has enlarged or emended in the decades since it was written, I suggested that, while I never found more than 2 eggs of this parasite in any single nest and while I knew of one hen that laid 2 eggs in each of two nests, the fact that the species appeared to be strictly monogamous and territorial implied that normally only one pair of screaming cowbirds (and, hence, only one female), would be apt to parasitize any one nest.

The matter of egg removal by the brown-headed cowbird merits further comment. In my experience, the primitive parasite, *M. rufo-axillaris*, does not remove eggs from its hosts' nests (although the bay-wing does so if any are present when it first takes possession of a nest), but the more advanced parasites, *M. bonariensis* and *M. ater*, frequently, if not regularly, do remove eggs of their hosts. In the case of *M. bonariensis*, the year-old birds tend to remain in flocks to a fair degree and to come into breeding condition late in the Argentine

summer. At this time many may lay together in old deserted nests, as many as 13 hens using the same nest and as many as 30 or 35 eggs being deposited in single nests. In these cases, the laying birds do not remove eggs from the nests. It looks as though egg removal in this species is an adult habit, not one found in subadult (year-old) birds. The fact that the nests used are deserted ones may have something to do with this, but more data are needed to clarify the situation.

The lack of egg removal, however, in the screaming cowbird and in its evolutionary descendant, the red-eyed cowbird, makes it possible to conclude that this habit is not an essential portion of a proprietary interest in a host nest although it is closely associated with such an interest. In the brown-headed cowbird egg removal is one manifestation of interest in the nest, one that becomes more readily interpreted if it is connected with a continued and proprietary interest.

While the cowbird may have an interest of some duration in some of the nests it has parasitized, this usually terminates long before the eggs hatch. Ordinarily, it shows no interest in the subsequent fate of the nest, eggs, or young, but there are in print a few observations of attention paid by female cowbirds to young of their own species. Bonwell (1895, p. 153) reported seeing a hen cowbird feeding a young one in a rose-breasted grosbeak's nest. "Nearly every evening she would come and feed the young cowbird, but if the young grosbeaks would open their mouths for food, she would peck them on the head and refuse them food. . . ." This account implies greater discrimination on the part of the cowbird than of the grosbeak, which seems highly unlikely. The whole incident reads as if it were "improved upon" by subsequent recollections, and, on the whole, it seems too far from the plain, unembellished record to be acceptable, and it may well be ignored. However, Forbush (1927, pp. 424–425) mentioned two other cases. He cited M. A. Walton's experience (1903, pp. 211–214) with a hen cowbird "which, as he believed, visited from time to time the nest in which her egg was laid, and finally fed and cared for her young one . . . ." From his acquaintance with Mr. Walton, Forbush was "inclined to believe that his observations were reported accurately, but that his deductions from those observations often were unwarranted by the facts. He 'believed' that this Cowbird made frequent visits to the 'Yellow Bird's' nest in which her egg was deposited but did not say that he saw this. However, he wrote that he saw her feeding her own young and assisting the male 'Yellow Bird' in feeding it, but he had no way of identifying the feeding Cowbird with the bird that laid the egg and no way of proving that the bird doing the feeding at different times was always the same individual."

To date, Walton's observations have remained unique, but they do establish that, in at least one instance, a brown-headed cowbird did

show interest in a host nest at a stage considerably later than the time of egg-laying. However, as Forbush correctly stated, it is not clear that this was a case of prolonged duration of such an interest.

The other case, also cited by Forbush, an observation by L. B. Fletcher (1925, pp. 22–24), had to do with a fledged cowbird already out of the nest. Fletcher trapped an adult female cowbird with a recently fledged young one, saw the former feed the latter, banded both birds, and released them. Later he saw the two together, the hen still feeding the young one. She fed only the banded fledgling and no others although there were other young cowbirds present. As Forbush correctly said, this is a reliable observation but affords no evidence to prove actual mother-and-child relationship. Such may be inferred, but not more than this, as many birds occasionally feed young other than their own. "It shows, however, that the adult cared for one particular young, which may have been her own."

Although of questionable pertinence here, an observation by Wiest near Butler, Pennsylvania, recently published by Preston (1961) in a local newspaper, should be mentioned. Wiest found a chipping sparrow's nest containing two eggs of its own and two cowbird eggs; he showed it to Preston, who removed the latter eggs. This was on May 18. The sparrows deserted the nest soon afterward. On May 30 Wiest saw a female cowbird visit the nest. She flew to it, fluttered her wings, flew down to the ground and again up to the nest in what seemed to the observer to be a state of excitement. Then she left but soon returned with four other cowbirds, two males and two females. (Wiest assumed that the original female was one of this party.) The five cowbirds tore the nest apart, eventually knocking it to the ground, and then flew off. In his report of this incident Preston felt it noteworthy that the time between the first observation on May 18 and the second on May 30 was "just about the time needed to hatch cowbird eggs, and if we surmise that the fluttering female was the mother of the eggs, or of one of them, then it looks as if she had come back to see if her offspring had hatched. Finding neither young cowbirds nor cowbird eggs, she seems to have called in her friends to destroy the nest of the negligent foster-parent. It is easy to read human motivation into bird behavior, and this is regarded as a deadly sin by ornithologists, but it is hard to avoid the conclusion that the fluttering female was the mother of at least one of those eggs, continued to be interested in it, and was greatly upset by what she found out."

It is obviously impossible to judge this case because there is no certainty that the "fluttering female" was the parent of one or both of the eggs or that she was even present in the aggressive action of the flock of five cowbirds. It should be mentioned that this destruc-

tive aggression against nests is something that has been noted in the case of captive female (and male) cowbirds when a nest was placed in the cage as a laying inducement. Certainly, in the case of the captive birds, there were no cowbird eggs involved and thus no possible question of parentage or of continuing interest in the nest.

Quite apart from an interest of shorter or longer duration in specific nests is the fact that very occasionally the brown-headed cowbird may reveal some nest-building atavisms. Lasky (1950, p. 160) twice noted a courting male bird "toying with a dead leaf or a piece of debris while bowing to a female," a residual "symbolic" nest-building act comparable to similar behavior in some self-breeding birds. There are in the literature two older statements involving much more than symbolic tokens of an earlier nest-building behavior. Although they are so contrary to the experience of all other observers as to seem doubtful, they should be mentioned here. Swain (1899) saw a pair of cowbirds carrying nesting material to a hole under the eaves of an old building. He noticed them doing this day after day for an unspecified number of days, but they disappeared soon afterward and made no attempt to use the nest structure. Here it is possible that there may have been a misidentification of the birds although this cannot be proved. The question of correct identification seems not to be involved in Honecker's (1902) statement, which is even more difficult to reconcile with what we know of the cowbirds. He kept a pair of these birds in a large cage and he wrote that the female built a nest in which she laid 4 eggs, incubated them, and reared all four young birds! Not only has no one else had this experience, but in recent years a number of investigators have been keeping cowbirds in aviaries, deliberately designed with facilities and conditions to induce breeding, and none of the investigators have had any such response. In fact, the most that any of them have reported is that occasional individual hens layed a few eggs in old nests supplied them as "inducers," but in no case did a cowbird attempt to incubate. In some cases, the only interest the cowbirds showed in the old nests was to tear them to pieces or to toss out of them any eggs, real or false, that had been placed in them to increase their possible suggestive value. An early instance of this adverse interest in nests by captive cowbirds was that reported in 1926 by Luttringer.

Interspecific Preening Invitational Behavior

Selander and La Rue (1961) recently have shown that brown-headed and bronzed cowbirds approach individuals of other bird species and solicit preening from them. The cowbirds do this by giving a special display which involves bowing their heads and ruffling somewhat the feathers on the back of their necks (where much of the preening takes

place). The observers found that the persistent repetition of this display often evoked preening behavior from a variety of birds, including redwinged blackbirds, meadowlarks, house sparrows, and shell parakeets (in captivity). Some birds, such as the common and great-tailed grackles, the inca and mourning doves, did not respond to the invitation to preen the cowbirds. Invitation to preening between cowbirds themselves is uncommon, and it appears to have no place in the provocation of interspecific preening. This display is given by adults and by birds of the year, by males and by females. The extent to which preening may go is sometimes surprising. Baird in Rhode Island and Behrendt (1960) in New York are cited by Selander and La Rue as having noted cases wherein invited house sparrows actually hopped onto the backs of the inviting cowbirds in order to preen them more effectively.

The authors suggest that the interspecific preening invitational display may be an adaptation for brood parasitism. This suggestion is based on the assumption that such behavior may lessen the possible hostile reactions of potential hosts to their would-be parasites. There is no evidence, however, to indicate that a female cowbird, about to lay in a nest, makes any effort to establish contact with its potential victim. It usually(?) enters the nest while the owner is away, lays its eggs as quickly as possible and leaves thereafter. Moreover, the invitation to preen is not given only, or even chiefly, to species that are frequently parasitized.

It is not clear what advantage could accrue to the cowbirds if, as adults, they became more acceptable to even the more frequently imposed upon species of their hosts. Such advantage appears unnecessary since there is evidence of hostility toward them on the part of only a small number of their victims (see pp. 33–34). In most cases there seems to be little need for greater acceptability, especially since the social contacts are short and relatively infrequent. Even in species wherein hostility to adult cowbirds is not noticeable (or, at least, has not been noticed), the individuals are apt to show excitement, possibly of an aggressive nature, when intruders come to their nests. Although it seems questionable whether or not there is any measurable advantage to the intruders to have had earlier preening association with the intended victims, this possibility cannot be ruled out arbitrarily: even slight differences of response in short and infrequent contacts may at times be critical.

In the light of present knowledge, it is not too safe to evaluate such behavior. It seems more in accord with the total evidence to interpret this relative ease with which cowbirds solicit preening from other birds as a result of brood parasitism, as a possible "memory induced" reaction based on early experience of care by adults of other species,

than as an adaptation to make the parasites more readily acceptable to their intended victims. Selander and La Rue themselves admit that they had no observations of cowbirds actually using this preening invitational display in an attempt to appease hostile hosts near their nests. They do cite Chapman's report (1928) of seeing a female giant cowbird, *Psomocolax oryzivorus*, twice bow her head and present the fluffed feathers of the nape to a female Wagler's oropendola, *Zarhynchus wagleri*, at the latter's nest, but even here there was no evidence of immediate intended parasitism.

One further thought should be expressed. Selander and La Rue write that the invitation to preen is "all the more unusual in that cowbirds only infrequently direct the invitational display to members of their own species and do not themselves indulge in social heteropreening." This suggests that we have here something akin to what, in human beings, might be looked upon as a "childhood memory," even though in each case the species invited to preen might be other than the actual fosterer of the inviting bird. The lack of identity of the invited preener with the original fostering species thus might be looked upon as an indication of a general absence of specific host imprinting on the parasite while a nestling. This would be not at all inconsistent with the general picture we have of cowbird-host relations.

Foster Parent-Offspring Relationship

In the discussion of the cowbird's invitational display for preening by other birds, it was suggested that such behavior might reflect, although faintly, some earlier experience with the alien species or, in broader terms, with "birds other than cowbirds." This suggestion naturally leads to the speculation as to whether or not nestling cowbirds become imprinted on their specific, individual fosterers; and this speculation, in turn, makes it advisable to review the entire question of imprinting, with special reference to parasitic birds.

So far as the behavior of the foster parent is affected, the hatching of a cowbird egg in its nest is no different from the hatching of one of its own, and from then on, until the young parasite is ready to fly and become independent, the adult host reacts to the chick just as it would to its own young. The fosterer acts, and seems, completely unaware of the substitution, even in cases wherein the young parasite grows to a size beyond that of the host's own typical offspring. This apparent unawareness or indifference is probably one of the conditions which permits brood parasitism to succeed.

On the other hand, the young cowbird differs from the young of its victims and of many other birds in that it reveals little or no evidence of becoming imprinted on its foster parents as a particular species. On the contrary, once it has fledged and has left the care of its foster parents, the young cowbird joins others of its own kind

even though its own species has been foreign to its experience until then. In effect, if the young parasite is imprinted at all, it is imprinted on its own species, without the need for external experiential stimuli.

In the past few decades, much work has been done on the behavior of birds in earliest post-hatching stages. From these investigations the concept of imprinting has emerged as one of the most important basic factors in the formulation of behavior—both in the immediate life of the nestling stage and even, by a supposedly ineradicable residual effect, in the future adult stage. In almost all discussions of this widespread phenomenon of imprinting, one thing, curiously, is overlooked: some brood parasites such as cowbirds show no signs of becoming imprinted on their foster-parents, certainly no signs which persist for any appreciable length of time after the bird leaves the nest. Since imprinting of the young on the parent has been found to be the case in an increasing list of bird species, the unusual absence of it in young cowbirds deserves further examination.

To begin with, we may take Emlen's definition (1955, p. 132) as a carefully considered expression of what is meant by the concept of imprinting. He considers it to be "a term applied to the rapid formation of stable primary stimulus–response associations or fixations during early infancy. It involves the selection of a stimulus situation for a newly developed and as yet unexpressed motor pattern and, once formed, may affect a wide variety of motor patterns. . . . Imprinting resembles conditioning but differs from it in that the association formed is not a substitution but an original creation, a primary association. It resembles the sign learning of Kellogg (1938), but again differs from it in being independent of previously established associations. It differs from trial-and-error learning in that it is an additive process and not used in problem solving. . . ." We may add to this the more descriptive definition given by Eibl-Eibesfeldt and Kramer (1958), who write that imprinting is "an early and nonselective or not discriminating innate response toward a particular object or individual, and is generally characterized by the fact it takes place only during a very early and very brief period in the life of the animal and that it appears to have a remarkably lasting and irreversible effect. The object fixation thus established by imprinting persists even after long periods in which that object is kept out of the animal's experience."

Imprinting was first detected in precocial birds: they were found to become fixed in their reactions by following the first moving object which they encountered with any degree of intimacy; subsequently, they were found to maintain a fixation upon the same object. In the case of nestlings of altricial birds, imprinting is ordinarily difficult

to determine for the simple reason that usually no birds other than the parents come to the nest and have any contact with the young birds. However, Hinde (1961, pp. 171–172) showed that the feeding behavior of altricial nestlings is originally responsive to quite diverse objects. "Once the eyes are open, young passerines will gape to a wide variety of objects—forceps, spatula, fingers and so on—as well as to the parent. . . . The stimuli evoking anxiety responses from young bullfinches are equally generalized . . . and the precocious adult behaviour of young birds . . . is often directed towards functionally inappropriate objects. . . ." Hinde uses the term imprinting simply for the learning of parental (for parasitic birds: the foster-parental) characteristics by young birds.

In the case of some brood parasites such as the European cuckoo, it is assumed generally that the host-specific egg-laying bird deposits its eggs in the nests of the same species of fosterer by which it originally was reared. In the absence of any more testable explanation, it has been assumed that each cuckoo becomes imprinted on its own foster-parent species. Whether or not this is true, the assumption hardly applies to the cowbirds; in these birds, the evidence for such specific host fixation is more in the nature of occasional rather than general occurrence. Even in cases of apparent host specificity, there is no corroborative evidence to make the possibility of imprinting anything more than an inference.

Reactions of Host to Parasitism

On the whole, the majority of American species of passerine birds do not act as if they recognize an enemy in the cowbird. At least, they do not attack or mob cowbirds on sight as some Palearctic birds attack the European cuckoo. Many writers have described the active hostility with which some of these potential victims react to the mere sight of a European cuckoo; other writers have recorded how certain African species resort to "mobbing" attacks on some of the small African glossy cuckoos or how the former drive off honeyguides. These accounts give the impression that the parasites are recognized as unwelcome intruders on sight, but this does not apply to most American birds when confronted with one or more cowbirds. There are exceptions, such as the tendency of redwinged blackbirds to repel cowbirds from their nesting areas (see pp. 128–129), but this antagonism holds only during the breeding season, whereas in some of the Old World birds, the hostility appears to be a fixed year-round pattern. Redwings and cowbirds certainly flock and roost together amicably in the autumn and winter months. Hann (1937, p. 201) studied the ovenbird, a very frequent victim of the brown-headed cowbird, and found no evidence of any innate hostility between them. The same lack of antagonism is the case in South America with the

shiny cowbird and its various hosts. The reactions of the hosts to the cowbirds is, then, not usually to the adult parasites but to the actual interference in the hosts' nests.

On several occasions Nice (1943, p. 158) noted song sparrows using a threat-posture against cowbirds and even striking them. A "threat note" was given against cowbirds, but not against them exclusively, as it was given also when the intruders were juncos, cardinals, and once even a young rabbit. Nice (p. 262) found that, if a hen cowbird came close to a nest, the pair of sparrows frequently attacked her. The antagonistic reactions of the sparrows to the cowbird seemed to depend on some conditioning in their past experience, either in early life or later; recognition of the cowbird was something learned, not innate, in the sparrows. Thorpe (1956, p. 121) considered that recognition of the parasite as an enemy might be based on an instinctive mechanism in some host species, but, in others, was probably something handed down from generation to generation, "not so much by the experience of the dire results of attack but by the alarm displayed by the parent birds or by members of other species when they see one of these enemies."

Birds react in several ways to the intrusion of cowbird eggs into their nests: they may accept them as if unaware of the eggs being different from their own (whether they are aware or not, we usually do not know); they may desert the nest and build a new one; they may build new nest linings over the strange eggs, thus effectively flooring over or burying them; or they may throw out the parasitic eggs. The same species may show more than one of these four reactions. In many species the reaction depends on whether or not the birds have already laid some eggs of their own prior to the moment of parasitism and also whether or not the cowbird removed one or more eggs or damaged the nest.

Many of the records, especially the older ones, have little or no supporting data; they are merely statements of sets of eggs collected, with places and dates. The following summaries of the three non-accepting reactions of the victims are based only on such cases as were reported with the pertinent observational data.

Nest desertion.—The reaction observers call actual desertion of the nest is frequently an inferred rather than an ascertained fact. In the following summary I have included only those species wherein the evidence points to a cause-and-effect relationship between parasitism and desertion. While accurate and detailed observations are still needed for proof, apparently nest desertion is more apt to occur when the parasite lays before the host has laid its first egg or at least when the host is still early in its own laying schedule.

The birds listed below have been observed at least once to desert

their nests when parasitized by the brown-headed cowbird. Their presence in this list should not be taken to imply that this is their regular response or even a fairly frequent reaction. In those species that tend to desert readily the word "frequently" is added. In two species the observational evidence suggested but did not prove that desertion was due to cowbird parasitism; to these the word "uncertain" has been added.

verdin
Bewick's wren (uncertain)
eastern bluebird
Bell's vireo
red-eyed vireo
yellow warbler
myrtle warbler
Maryland yellowthroat
yellow-breast chat (frequently)
redwinged blackbird
scarlet tanager (uncertain)
cardinal (frequently)
painted bunting (frequently)
field sparrow (frequently)

Burying cowbird eggs under new nest-lining.—Several kinds of cowbird hosts have been found which disposed of the parasitic eggs by burying them under new nest linings and then proceeded with further egg laying on the new floor. Because this has the appearance of clever resourcefulness, it has been described many times and has often been overinterpreted in some anthropomorphic accounts.

The explanation of this "flooring over," first advanced by F. H. Herrick (1910), still seems very plausible, and is, in fact, the only one which presents the picture on its proper behavioristic level. Herrick studied the cyclical instincts of birds; i.e., migration, courtship, mating, nest-building, egg-laying, incubation, etc. He found that, if the cycle were disturbed at any point, the birds would go back one stage in the cycle and start again from that point. Thus, if the egg-laying stage was disturbed by some cause, the birds would go back to nest-building: they would build a new nest and then resume egg-laying. In the case of a cowbird victim, the egg-laying is disturbed by the introduction into the nest of a cowbird's egg. According to Herrick's analysis, the bird should desert—as many birds do—and build another nest. However, the victimized bird may be so attached to its nesting site that it cannot easily break away. At the same time, the interference it has suffered prompts it to build another nest. There is then a conflict between the two instinctive drives—the one tending to hold the bird to the nesting-site, the other tending to pull it away to build a new nest. The forces appear to be fairly equal, and the outcome is not predictable in any one case. The presence of eggs of its own in the nest strengthens the attachment of the bird to the site and nest, and it is this force probably that wins out in many cases. The new floor, covering the parasitic eggs, is thus to be interpreted as comparable to a new nest, such as the sequence of the cyclical instincts would demand, but placed directly in or on the old one, due to the strong site attach-

ment. However, the presence of the host's *own* eggs in the nest tends to make the contest more unfavorable to the cyclical sequence; in such a situation the cowbird's eggs are frequently accepted along with the host's eggs which are already present.

As might be expected of a purely instinctive behavioral reaction, the victimized bird may at times cover over the wrong eggs. Mousley (1916, p. 178) reported a yellow warbler's nest containing 4 eggs of its own and 1 cowbird egg, while 1 of the warbler eggs was covered over by nest-lining. He removed the cowbird egg and raised the embedded warbler egg, freeing it of the materials placed over it. Revisiting the nest three days later, he found that the warbler had embedded 2 of her own eggs. The interference caused by his well-intended actions had the same effect as if a cowbird had deposited another egg in the nest.

In some species of hosts, the "flooring over" behavior has been noted frequently, chiefly in the yellow warbler, which has been known to follow this pattern repeatedly in cases where the parasite persisted in revisiting the nest. This would often result in two-, three-, four-, five-, and even six-storied nests, in the lower stories of which were buried cowbird eggs with or without some of the warbler's own. In other species, this reaction behavior has been recorded less often, sometimes only once or twice. However, the fact that it has been found to occur indicates the wide distribution of the pattern. This, in turn, seems to bear out Herrick's concept that what is involved is an interruption of a basic cyclical pattern and not something peculiar to one or a few host species. In still other frequently imposed-upon hosts, such as the eastern phoebe, wood thrush, veery, ovenbird, Maryland yellowthroat, rufous-sided towhee, and chipping sparrow, flooring over has not been reported as yet.

The following species have been found to bury cowbird eggs beneath new nest linings:

eastern kingbird
eastern phoebe
Acadian flycatcher
Traill's flycatcher
bush-tit
catbird
blue-gray gnatcatcher
Bell's vireo
yellow-throated vireo
solitary vireo
red-eyed vireo
warbling vireo
prothonotary warbler
yellow warbler
myrtle warbler
chestnut-sided warbler
prairie warbler
Kentucky warbler
yellowthroat
American redstart
eastern meadowlark
redwinged blackbird
Baltimore oriole
cardinal
indigo bunting
American goldfinch
clay-colored sparrow
white-crowned sparrow
song sparrow

Birds that evict the parasitic eggs.—Throwing the parasitic eggs out of the nest is the least frequent reaction recorded in cowbird hosts. Most of the smaller species of victims probably would be unable to do so if they wanted to, and some of the larger ones seem to vary individually in this reaction. Egg eviction has been recorded for the following hosts:

eastern kingbird (evidence inconclusive)
purple martin
catbird (regularly)
robin (regularly)
wood thrush (locally frequently)
Bell's vireo
Baltimore oriole
Bullock's oriole

Hosts Known To Have Reared Young of Parasite

The mere fact that a cowbird lays an egg in the nest of a given species of bird does not imply that the chosen victim is necessarily able to act as a successful fosterer. The parasite frequently deposits eggs in nests of unwilling or unsuitable bird victims. From the standpoint of the cowbird, these are lost eggs: the maintainance of its species depends on its placing enough eggs in nests of the right kinds of birds and in having enough of these eggs hatch young which reach maturity.

In compiling the list of successful fosterers, I have used as a minimum criterion of success the situation of a nest containing a healthy nestling cowbird which is more than half grown and largely feathered, i.e., within a few days of fledging or leaving the nest. The degree of development attained at this stage seems a fairly safe indication that the foster parents were able to feed properly and care adequately for the growing cowbird chick.

If we were to be more exacting and require actual fledging as a measure of success, our list would suffer unduly from the effects of external causes, such as predators that frequently take young birds out of nests regardless of whether they are parasites or rightful young. Since our interest at this point is to determine the innate suitability of the foster species, it seems overcritical to reject evidence that is short of full fledging success. The ability to continue to the fledging stage may be safely deduced from a bird which has developed rapidly and well, even if the observation does not continue to the time of leaving the nest. There is no good reason for thinking that any given host species which could hatch and rear a young cowbird for the first week or more of its nestling stage could not be able to complete the task. Any later factors of interference, such as predators, storms, or accidents to the foster parents are outside the concept of host suitability.

So far, we have been discussing merely the ability of the various hosts to feed and take care of a young cowbird. Other factors also play a role in determining the suitability of a host. One is the accessibility of its nest to a cowbird about to lay. Birds nesting in cavities with very small entrance holes are not ordinarily "available" but occasionally are parasitized, probably when the entrance to the nest is unusually large or has been tampered with. Such a case is that of the brown creeper listed on page 39.

Another factor is the intended victim's alertness or pugnacity that tends to protect it from being imposed upon by the parasite. One group of passerine birds, the nests of which are suitable but which have not been known to be parasitized, is the shrike family. I have long ago attributed the immunity of the shrikes to their pugnacious, aggressive nature, which would cause them to attack and to drive off, if not actually kill, any intruding, would-be parasite. Many years ago I expressed this opinion to a correspondent, L. B. Potter of Eastend, Saskatchewan, who decided to test the white-rumped shrike, *Lanius ludovicianus*, as a potential foster-parent of a cowbird. Potter (1939, pp. 219–220) published a brief account of what he found, which may be supplemented by the following, taken from his letter of August 1934.

He placed a partly incubated cowbird's egg in a shrike's nest containing 6 eggs, one of which he removed. A week later, revisiting the nest, he found that the cowbird had hatched but the shrike's eggs had not. The shrikes obviously had been feeding the young parasite as it was in good condition. Three days later, the cowbird had grown appreciably and the shrike's eggs remained unhatched. The adult shrikes, busy with caring for their parasitic young, had stopped incubating. Mr. Potter concluded that the shrikes treated the young cowbird just as they normally would one of their own chicks. This crude experiment makes it seem all the more probable that it is the pugnacity of the shrikes toward an approaching adult cowbird and not an inability to hatch and feed a young cowbird that is the reason the shrikes have remained free from the attentions of the parasite.

The following list contains 101 species, or a little less than half of all the species known to have been imposed upon by the brown-headed cowbird. While other birds undoubtedly will be added in the future, it seems that the percentage of the total host catalog that may be considered "successful" choices for the parasite will remain about as given here.

One further thought might be expressed before listing the rearing hosts. From the standpoint of the population economy of the parasite, there is a great difference between a host species that occasionally manages to bring up one young cowbird and a host that does so

regularly and, at times, rears multiple young of the parasite. As an example of an extremely successful host, we might mention the song sparrow, of which species Salmon (1933, p. 100) recorded an instance wherein three young cowbirds were reared, and Lees (1939, p. 121) reported a case wherein no less than five young cowbirds were seen attended by a pair of these sparrows.

In the list given below I have attempted to evaluate the various species on the basis of the actual records of their having raised young cowbirds. This has resulted in some cases in a rather deceptive definiteness, which merits explanation at this point. In compiling the data for this list, I have often come across published statements to the effect merely that a given species was parasitized, without any further details. These I have concluded were probably egg records and I have not used them here. In addition, the absence from this list of some species which are included in the total host catalog may be due to the fact that many of the actual published data were contributed by egg collectors, who took the eggs they found, rather than let them hatch; or the absence may be due to the fact that the data were reported by passing observers who did not have the time, opportunity, or interest to revisit the nests to learn the eventual outcome of each.

A consequence of this, reflected in the comments given after each species, has been to present as equally valid quantitative estimates the data from casual observations with the results from much fuller knowledge in other species. In order to show the scope of the information from which I have deduced the degree to which each host has been a success for the parasite, I have added, where it seemed desirable, the total number of records of cowbird parasitism known to me. In such cases, the accounts of the individual species in the catalog may be consulted for further details.

mourning dove: one instance (with an element of doubt)
eastern kingbird: once (out of 15 records of parasitism)
scissor-tailed flycatcher: once (out of a very few records of parasitism)
eastern phoebe: frequently
Acadian flycatcher: several times
Traill's flycatcher: several times
western flycatcher: twice (out of 6 records of parasitism)
eastern wood pewee: frequently
tree swallow: at least once (out of a small number of records of parasitism)
black-capped chickadee: once (out of 4 records of parasitism)
brown creeper: one instance (only record of parasitism)
wrentit: once (out of 4 records of parasitism)
house wren: three times (out of 6 records of parasitism)
Carolina wren: once (out of a dozen or so records of parasitism)
catbird: twice (out of 22 records of parasitism)
brown thrasher: several times
wood thrush: several times
hermit thrush: twice (out of about 20 records of parasitism)

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veery: frequently
blue-gray gnatcatcher: frequently
black-tailed gnatcatcher: twice (out of 10 records of parasitism)
ruby-crowned kinglet: once (out of 6 records of parasitism)
cedar waxwing: several times
phainopepla: once (out of 2 records of parasitism)
black-capped vireo: once (out of 11 records of parasitism)
white-eyed vireo: frequently
Hutton's vireo: twice (out of 5 records of parasitism)
Bell's vireo: infrequently
yellow-throated vireo: frequently
solitary vireo: frequently
red-eyed vireo: frequently
Philadelphia vireo: once (out of 2 records of parasitism)
warbling vireo: frequently
black-and-white warbler: several times
worm-eating warbler: twice (out of 37 records of parasitism)
golden-winged warbler: several times
blue-winged warbler: several times
Tennessee warbler: once (out of 6 records of parasitism)
Nashville warbler: once (out of 16 records of parasitism)
Virginia's warbler: once (only record of parasitism)
Lucy's warbler: twice (out of 5 records of parasitism)
yellow warbler: frequently
magnolia warbler: once (out of 17 records of parasitism)
black-throated blue warbler: twice (out of 9 records of parasitism)
myrtle warbler: frequently
black-throated gray warbler: once (out of 2 records of parasitism)
black-throated green warbler: several times
golden-cheeked warbler: twice (out of 8 records of parasitism)
hermit warbler: once (only record of parasitism)
cerulean warbler: once (out of 12 records of parasitism)
Blaekburnian warbler: twice (out of a few records of parasitism)
Grace's warbler: once (out of 2 records of parasitism)
chestnut-sided warbler: frequently
pine warbler: several times
Kirtland's warbler: frequently
prairie warbler: several times
ovenbird: frequently
Louisiana waterthrush: frequently
Kentucky warbler: several times
mourning warbler: several times
MacGillivray's warbler: twice (out of 8 records of parasitism)
yellowthroat: frequently
yellow-breasted chat: frequently in some areas; not at all in others
hooded warbler: twice
Canada warbler: twice (out of less than a dozen records of parasitism)
American redstart: frequently
house sparrow: twice (out of 7 records of parasitism)
bobolink: twice (out of 22 records of parasitism)
redwinged blackbird: once (out of 180 records of parasitism)
orchard oriole: several times
Baltimore oriole: twice (out of 14 records of parasitism)
hooded oriole: twice (out of a few records of parasitism)
Bullock's oriole: once (out of 4 records of parasitism)
western tanager: once (out of 3 records of parasitism)
scarlet tanager: several times
summer tanager: several times
cardinal: several times
rose-breasted grosbeak: several times
blue grosbeak: once (out of about 30 records of parasitism)
indigo bunting: frequently
painted bunting: several times
evening grosbeak: once (only instance of parasitism)
pine siskin: twice (out of 10 records of parasitism)
American goldfinch: several times
rufous-sided towhee: frequently
Savannah sparrow: twice (out of 27 records of parasitism)
LeConte's sparrow: once (out of 6 records of parasitism)

seaside sparrow: once (only record of parasitism)
vesper sparrow: several times
lark sparrow: twice (out of about 30 records of parasitism)
white-winged junco: twice (out of 2 records of parasitism)
slate-colored junco: several times
Oregon junco: once (out of 2 records of parasitism)
chipping sparrow: frequently
clay-colored sparrow: frequently
Brewer's sparrow: twice (out of 3 records of parasitism)
field sparrow: several times
white-throated sparrow: several times
fox sparrow: at least once (out of a few records of parasitism)
swamp sparrow: several times
song sparrow: frequently

Hosts of the Brown-headed Cowbird

Summary

Hosts	*Molothrus ater*			Hosts	*Molothrus ater*		
	ater	*artemisiae*	*obscurus*		*ater*	*artemisiae*	*obscurus*
Anas discors		x		Hirundo rustica erythrogaster	x		
Buteo regalis		x		Petrochelidon pyrrhonota	x		
Charadrius vociferus	x			Progne subis subis	x		
Bartramia longicauda	x			Cyanocitta cristata bromia	x		
Steganopus tricolor		x		Corvus brachyrhynchos brachyrhynchos	x		
Larus californicus		x		Parus atricapillus atricapillus	x		
Zenaidura macroura macroura	x			Parus carolinensis extimus	x		
" " marginella		x		Parus bicolor	x		
Columbigallina passerina pallescens			x	Parus atricristatus sennitti			x
Coccyzus americanus	x			Auriparus flaviceps annexus			x
Coccyzus erythrophthalmus	x			Psaltriparus minimus minimus			x
Archilochus colubris	x			" " californicus			x
Melanerpes erythrocephalus	x			Sitta carolinensis cookei	x		
Tyrannus tyrannus	x	x		Sitta canadensis		x	
Tyrannus verticalis		x		Certhia familiaris americana	x		
Tyrannus vociferans			x	Chamaea fasciata rufula			x
Muscivora forficata	x		x	" " henshawi			x
Myiarchus crinitus boreus	x			Troglodytes aedon baldwini	x		
Sayornis phoebe	x	x		" " parkmanii	x	x	
Sayornis nigricans nigricans			x	Thryomanes bewickii bewickii	x		
Sayornis saya saya	x			" " altus	x		
Empidonax flaviventris		x		" " cryptus			x
Empidonax virescens	x			Thryothorus ludovicianus ludovicianus	x		x
Empidonax traillii brewsteri		x	x	Salpinctes obsoletus obsoletus	x	x	
" " traillii	x	x		Mimus polyglottos polyglottos	x		
Empidonax minimus	x	x		" " leucopterus	x		x
Empidonax difficilis			x	Dumetella carolinensis	x	x	
Contopus virens	x			Toxostoma rufum rufum	x		
Contopus sordidulus veliei		x	x	" " longicauda		x	
Nuttallornis borealis		x		Toxostoma longirostre sennetti			x
Pyrocephalus rubinus mexicanus			x	Toxostoma bendirei			x
" " flammeus			x	Toxostoma curvirostre oberholseri			x
Eremophila alpestris leucolaema		x		Oreoscoptes montanus		x	
" " enthymia		x		Turdus migratorius migratorius	x	x	
" " praticola	x	x		" " achrusterus	x		
Iridoprocne bicolor	x			" " propinquus		x	
Riparia riparia riparia	x						

Summary—Continued

Hosts	*Molothrus ater*		
	ater	*artemisiae*	*obscurus*
Hylocichla mustelina	x		x
Hylocichla guttata guttata		x	
" " polionota		x	
" " auduboni		x	
" " faxoni	x		
Hylocichla ustulata ustulata			x
" " swainsoni	x	x	
Hylocichla fuscescens fuscescens	x		
" " fuliginosa	x		
" " salicicola	x	x	
Slalia sialis sialis	x	x	x
Sialia mexicana bairdi			x
Sialia currucoides		x	
Polioptila caerulea caerulea	x		x
" " amoenissima		x	x
Poloptila melanura lucida			x
" " californica			x
" " margaritae			x
Regulus calendula calendula	x	x	
" " cineraceus		x	
Anthus spragueii		x	
Bombycilla garrula		x	
Bombycilla cedrorum	x	x	
Phainopepla nitens lepida			x
Sturnus vulgaris	x		
Vireo atricapilla	x		x
Vireo griseus noveboracensis	x		
" " micrus			x
Vireo huttoni huttoni			x
" " stephensi	x		x
Vireo nanus			x
Vireo bellii bellii	x		
" " medius			x
" " arizonae			x
" " pusillus			x
Vireo vicinior			x
Vireo flavifrons	x		
Vireo solitarius solitarius	x	x	
" " alticola	x		
" " plumbeus	x	x	x
" " cassinii		x	x
Vireo flavoviridis			x
Vireo olivaceus	x	x	x
Vireo philadelphicus	x	x	
Vireo gilvus gilvus	x		
" " swainsonii	x	x	x
" " leucopolius		x	
Neochloe brevipennis brevipennis			x
Mniotilta varia	x	x	
Protonotaria citrea	x		
Limnothlypis swainsonii	x		
Helmitheros vermivorus	x		
Vermivora chrysoptera	x		

Hosts	*Molothrus ater*		
	ater	*artemisiae*	*obscurus*
Vermivora pinus	x		
Vermivora peregrina	x	x	
Vermivora celata lutescens		x	
Vermivora ruficapilla ruficapilla	x	x	
Vermivora virginiae		x	
Vermivora luciae			x
Parula americana	x		x
Dendroica petechia aestiva	x	x	
" " amnicola		x	
" " rubiginosa		x	
" " morcomi	x	x	x
" " sonorana			x
Dendroica magnolia	x	x	
Dendroica tigrina	x		
Dendroica caerulescens caerulescens	x		
Dendroica coronata coronata	x	x	
Dendroica auduboni auduboni		x	
" " memorabilis		x	
Dendroica nigrescens		x	x
Dendroica virens virens	x		
Dendroica chrysoparia			x
Dendroica occidentalis			x
Dendroica cerulea	x		
Dendroica fusca	x		
Dendroica dominica albilora	x		
Dendroica graciae		x	x
Dendroica pensylvanica	x	x	
Dendroica castanea	x		
Dendroica pinus pinus	x		
Dendroica kirtlandii	x		
Dendroica discolor discolor	x		
Dendroica palmarum palmarum		x	
" " hypochrysea	x		
Seiurus aurocapillus aurocapillus	x	x	
Seiurus noveboracensis noveboracensis	x		
Seiurus noveboracensis notabilis	x		
Seiurus motacilla	x		
Oporornis formosus	x		
Oporonis philadelphia	x	x	
Oporornis tolmiei monticola		x	
" " tolmiei		x	
Geothlypis trichas brachydactylus	x		
" " trichas	x		
" " ignota	x		
" " campicola		x	
" " occidentalis		x	
" " insperata			x
" " chryseola			x
" " arizela		x	
" " sinuosa			x
" " scirpicola			x

Summary—Continued

Hosts	*Molothrus ater*		
	ater	*artemisiae*	*obscurus*
Chamaethlypis poliocephala poliocephala			x
Icteria virens virens	x	x	
" " auricollis	x	x	x
Wilsonia citrina	x		
Wilsonia pusilla pusilla		x	
" " chryseola			x
Wilsonia canadensis	x	x	
Setophaga ruticilla tricolora	x	x	
" " ruticilla	x		
Passer domesticus	x	x	x
Dolichonyx oryzivorus	x	x	
Sturnella magna magna	x		
" " argutula	x		
" " hoopesi			x
Sturnella neglecta	x	x	
Xanthocephalus xanthocephalus	x	x	x
Agelaius phoeniceus phoeniceus	x		
" " littoralis	x		x
" " megapotamus	x		x
" " arctolegus	x	x	
" " fortis	x	x	
" " nevadensis		x	
" " californicus		x	x
" " neutralis			x
" " sonoriensis			x
Icterus spurius	x		x
Icterus graduacauda audubonii			x
Icterus cucullatus sennetti			x
" " nelsoni			x
Icterus galbula	x	x	
Icterus bullockii bullockii	x		x
" " parvus			x
Euphagus carolinus carolinus	x	x	
Euphagus cyanocephalus	x	x	x
Quiscalus quiscula versicolor	x	x	
Piranga ludoviciana		x	
Piranga olivacea	x		
Piranga rubra rubra	x		
" " cooperi	x		x
Richmondena cardinalis cardinalis	x		
" " magnirostris	x		
" " canicaudus	x		x
" " superba			x
Pyrrhuloxia sinuata sinuata			x
" " fulvescens			x
Pheucticus ludovicianus	x	x	
Pheucticus melanocephalus melanocephalus	x	x	
Guiraca caerulea caerulea	x		
" " interfusa	x		x
" " salicaria			x
Passerina cyanea	x		x
Passerina amoena		x	x
Passerina versicolor versicolor			x
Passerina ciris ciris	x		
" " pallidior			x
Spiza americana	x		x
Hesperiphona vespertina vespertina	x		
Carpodacus purpureus purpureus	x	x	
Carpodacus mexicanus frontalis	x	x	x
Sporophila torqueola sharpei			x
Acanthis flammea flammea		x	
Spinus pinus pinus	x	x	
Spinus tristis tristis	x		
" " pallidus		x	
" " salicamans			x
Spinus psaltria psaltria			x
" " hesperophilus			x
Spinus lawrencei			x
Loxia curvirostra pusilla	x		
Arremonops rufivirgata rufivirgata			x
Chlorura chlorura	x	x	
Pipilo erythrophthalmus erythrophthalmus	x	x	
" " canaster	x		
" " arcticus		x	
" " montanus		x	x
" " curtatus		x	
" " oregonus		x	
" " falcifer			x
" " megalonyx			x
Pipilo fuscus senicula			x
" " mesoleucus	x		x
Pipilo aberti aberti			x
" " dumeticolus			x
Melozone kieneri rubricatum			x
Calamospiza melanocorys		x	
Passerculus sandwichensis labradorius	x		
" " savanna	x		
" " oblitus	x	x	
" " nevadensis		x	
Ammodramus savannarum pratensis	x		
" " perpallidus	x	x	
" " ammolegus			x
Ammodramus bairdii		x	
Passerherbulus caudacutus	x	x	
Passerherbulus henslowii susurrans	x		
" " henslowii	x		
Ammospiza caudacuta nelsoni		x	

Summary—Continued

Hosts	*Molothrus ater*			Hosts	*Molothrus ater*		
	ater	*artemisiae*	*obscurus*		*ater*	*artemisiae*	*obscurus*
Ammospiza maritima maritima	x			Zonotrichia albicollis	x	x	
Pooecetes gramineus gramineus	x			Passerella iliaca zaboria		x	
" " confinis		x	x	" " schistacea		x	
Chondestes grammacus grammacus	x	x		" " olivacea		x	
Chondestes grammacus strigatus	x	x	x	" " swarthi		x	
Aimophila carpalis			x	" " fulva		x	
Aimophila aestivalis bachmani	x			" " monoensis		x	
" " illinoensis	x			Melospiza lincolnii lincolnii	x	x	
Aimophila cassinii	x		x	Melospiza georgiana ericrypta		x	
Amphispiza bilineata bilineata			x	" " georgiana	x		
" " opuntia			x	Melospiza melodia melodia	x		
" " deserticola			x	" " atlantica	x		
Amphispiza belli nevadensis		x		" " euphonia	x		
Junco aikeni		x		" " juddi	x	x	
Junco hyemalis hyemalis	x	x		" " montana		x	
" " carolinensis	x			" " inexpectata		x	
" " cismontanus		x		" " merrilli		x	
Junco oreganus montanus		x		" " fisherella		x	
" " pinosus			x	" " morphna		x	
Spizella passerina passerina	x			" " cleonensis			x
" " arizonae	x		x	" " gouldii			x
" " borcophila		x		" " samuelis			x
Spizella pallida	x	x		" " pusillula			x
Spizella breweri breweri	x	x		" " heermanni			x
Spizella pusilla pusilla	x			" " cooperi			x
" " arenacea		x		" " fallax		x	x
Spizella atrogularis evura			x	" " saltonis			x
" " cana			x	Rhynchophanes mccownii		x	
Zonotrichia leucophrys leucophrys	x			Calcarius ornatus		x	
" " oriantha		x					

Blue-winged Teal

Anas discors Linnaeus

One record of this most unlikely host species has been published by W. J. Hamilton III (1957, p. 279), who flushed a female blue-winged teal from an empty nest on June 2, 1956, near Delta, Manitoba. Six days later, he found that the nest contained the remains of 3 teal eggs, apparently destroyed by a skunk, and with them were 2 cowbird eggs. On June 11, another cowbird egg was found on the open ground about 30 yards from the destroyed teal nest. As Hamilton properly remarks, occasionally a female cowbird may be obliged to deposit an egg in an inappropriate spot; the fact that 2 eggs were laid in this nest and another nearby suggests that the parasites may have been finding it difficult to locate more suitable depositories in the immediate vicinity.

Although the record stands, it hardly warrants looking upon the blue-winged teal as anything but an accidental "host" of the cowbird. Indeed, there is no evidence that the teal was still in possession of its nest when the first cowbird egg was laid. The cowbird involved in this record is of the race *artemisiae*.

Ferruginous Hawk

Buteo regalis (Gray)

This very sizeable hawk cannot be looked upon as anything but a purely accidental host of the brown-headed cowbird. The only known record, which involves the northwestern race, was noted near Bottineau, North Dakota, May 3, 1894, by Alfred Eastgate, who found a nest with 4 eggs of the hawk and 1 of the cowbird.

Killdeer

Charadrius vociferus (Linnaeus)

The killdeer is in our catalog solely on the basis of its inclusion in a list of cowbird victims in Oberholser's unpublished manuscript on the birds of Texas. As I stated in my book (1929, p. 205), the data supporting this inclusion were not placed on record, and from conversation with the compiler I find that at this late date it is highly unlikely that the data will come to light. The bird is obviously inappropriate as a host species, and it cannot be looked upon as other than an accidental victim of the parasite. Even the word "victim" hardly applies; if the eggs had been left to hatch, the killdeer still would have suffered no inconvenience.

Upland Plover

Bartramia longicauda (Bechstein)

The upland plover is another accidental host, for which there is but a single record—a nest found in Minnesota, containing 4 eggs of the upland plover plus 1 of the brown-headed cowbird. According to information received from the late J. H. Bowles, in whose collection the eggs were at the time, the cowbird egg was almost buried in the bottom of the nest.

Wilson's Phalarope

Steganopus tricolor Vieillot

At Bear River Refuge, Utah, June 3, 1938, Williams and Trowbridge (1939, p. 77) found two nests of this bird parasitized by the northwestern race of the brown-headed cowbird. The nests were about 25 yards apart and were fairly well concealed in damp salt-grass on a small, artificial island in the lower marshes. "Each contained four phalarope and two cowbird eggs. Since these instances seemed from available information to constitute a new host record, subsequent visits to the nest were made to learn the ultimate fate of the eggs.

On June 21, it was found that all the phalarope's eggs in one nest had hatched and the two cowbird's eggs were left. These were later flooded. In the second nest, on June 28, three phalarope's eggs were found hatched. The remaining phalarope's egg was pipped but had been destroyed by flooding along with the cowbird's eggs. One of the cowbird's eggs in the first nest was evidently infertile, but the others were advanced in development."

California Gull

Larus californicus Lawrence

There is but one record for this unusual and apparently accidental victim. Alfred Eastgate wrote me many years ago that in June 1899 he found a nest of this gull containing several eggs of its own and one of the cowbird in an area that "later became the National Bird Reserve of Shrimp Lake." I was never able to locate "Shrimp Lake," and only recently have I found that it was a miswriting for "Stump Lake," which is a national bird reserve in North Dakota, the state in which Eastgate is known to have done most, if not all, his field work. A gull is obviously unsuitable as host for a cowbird, and all that can be said for this record is that on at least one occasion a cowbird made the mistake of laying in a nest of this bird. The cowbird here involved is the race *artemisiae*.

Mourning Dove

Zenaidura macroura (Linnaeus)

The mourning dove is decidedly an uncommon victim of the brown-headed cowbird, but it has been recorded as a host at least six times, four records of which refer on geographic grounds to the eastern, nominate race of the dove and of the cowbird, and one to the western race *Z.m. marginella*. We may dispose of the latter one quickly as no data concerning it are available. It is based solely on the fact that, in the list of cowbird victims in his unpublished manuscript on Texan birds, Oberholser included the western mourning dove, but he gave no supporting information as to the source or conditions of his record. The other five are as follows: E. H. King informed Coues (1884, p. 293) that he found the mourning dove to be parasitized in eastern Iowa, probably near West Liberty; Hicks (1934, p. 396) noted a similar case in Franklin County, Ohio; A. J. Berger (1960, p. 118) found a nest near Ann Arbor, Michigan, which contained a young mourning dove and a fresh cowbird egg (when first seen, it had held 2 dove eggs and 1 of the cowbird); Dr. Richard F. Johnston (in litt.) informed me that, out of 1,010 nests of the mourning dove found in Kansas, one contained an egg of the brown-headed cowbird; and C. D. Kellogg (1900, p. 121) observed a parasitized nest at Rock Hill, Pennsylvania, on May 25, 1899.

Only in the last case are there any details; the observer left the following account. He found 15 or more doves' nests in one orchard on May 25, and he noticed a cowbird flutter off a large grackle's nest, which, on examination, was found to contain only a single cowbird egg. Three days later, he noted that a mourning dove had deposited 2 eggs in this nest. He was unable to visit the nest again until three weeks later, when it contained a young cowbird almost ready to fly. Although he waited for some time, he did not see the doves return to feed the young parasite.

This account is accompanied by a photograph of the nest, showing the young cowbird and the 2 dove's eggs, but it is not as completely convincing as it might appear to be. Kellogg did not actually see the doves at the nest, and, secondly, the original builders of the nest, the grackles, might have taken over the nest and hatched and reared the cowbird. Thirdly, it would be theoretically difficult for a dove to rear a cowbird because of the lack of attunement in their feeding habits. The cowbird chick agrees with nestlings of most other passerine birds in its mode of feeding. At the approach to the nest of the adult food-laden bird, the nestlings open wide their bills and the adult thrusts the food with its bill into the throats of the young. The dove, however, reverses the process: the adult opens its mouth, into which the young thrust their bills for food. It would seem that a young cowbird and an adult mourning dove might have difficulties in adjusting to this difference. This is what raises a question as to the proper interpretation of Kellogg's record.

A possible sixth record is the following. Watkins (1900, p. 71) writes that cowbird eggs have been found in the nests of several species of birds that nest in open meadows in Michigan, among which he lists the mourning dove. However, in his account of the dove, he mentions only a single instance of ground nesting by this bird in open meadows, and in that one no mention is made of any cowbird eggs. It is, therefore, not clear if Watkins knew of a Michigan record, or merely mentioned the mourning dove because of the then fairly recent Iowa record published a few years earlier by Coues. Other writers who have listed the mourning dove as a cowbird victim, such as Bendire (1893) and Davie (1889), obviously were merely compiling earlier statements.

Ground Dove

Columbigallina passerina (Linnaeus)

This dove is a rarely victimized species, for which there are only two records, both from near Brownsville, Texas, and both having to do with the dwarf race *obscurus* of the brown-headed cowbird. In May, 1925, I examined about a dozen nests of the ground dove, one of which, found on May 23, contained 1 cowbird egg in addition to

the usual 2 of the host. The late R. D. Camp told me at the time that once he had found a similar case in the same area years earlier. The ground dove in these two cases is of the subspecies *C.p. pallescens*.

Yellow-billed Cuckoo

Coccyzus americanus (Linnaeus)

This bird has been reported as a victim of the brown-headed cowbird on three occasions. W. E. Loucks found a cowbird's egg in a yellow-billed cuckoo's nest near Peoria, Illinois, some time prior to 1893. Trautman (1940, p. 273, 393) recorded a nest containing 5 eggs of the cuckoo and 1 of the cowbird at Buckeye Lake, Ohio. In the collections of the Museum of Natural History of the University of Minnesota is another record—a parasitized set of eggs taken at Farmington, Connecticut, by Franklin Benner, on June 8, 1875. As I stated in an earlier paper (1949, p. 158), the Loucks record is the basis for the inclusion of this cuckoo in Bendire's list (1893) of cowbird hosts, presented therein without any supporting evidence. The parasite in both cases was of the typical race *M.a. ater*.

Black-billed Cuckoo

Coccyzus erythrophthalmus (Wilson)

Three parasitized nests of this cuckoo have been reported. One near Buffalo, New York, was found by Morris and Eames (Friedmann, 1943, p. 353); one in Maryland was reported by Stewart and Robbins (1958, p. 329). The data on the latter instance, kindly sent me by R. E. Stewart, are that the nest contained 1 egg of the cuckoo and 1 of the brown-headed cowbird; it was observed in Anne Arundel County, Maryland, May 26, 1932. The third case, a nest with 2 eggs of the cuckoo and 1 of the cowbird, was found at Ste. Dorothée, Laval County, Quebec, June 15, 1938, by Wm. J. Brown of Westmount, Montreal. I am indebted to Mr. L. M. Terrill for sending me this record. In all three cases the typical, eastern race of the cowbird is involved.

Ruby-throated Hummingbird

Archilochus colubris (Linnaeus)

The ruby-throated hummingbird is in this catalog on the basis of one record, unfortunately without supporting details. According to F. B. Webster (1891, p. 109), M. S. Culver of Medford, Massachusetts, in July, 1890, found a nest of this bird containing a single cowbird's egg. I commented earlier (1929, p. 207) that I could not help but wonder if the nest might have been a wood pewee's, but it seems better to assume that the observer correctly identified what he saw, especially since he noted that the egg completely filled the nest.

Red-headed Woodpecker

Melanerpes erythrocephalus (Linnaeus)

The red-headed woodpecker is a rarely victimized bird. It is mentioned in the lists of cowbird victims by Bendire and by Davie without any supporting details. The late Lynds Jones wrote me many years ago that he had taken a cowbird's egg from the nest of a red-headed woodpecker in Ohio. Whether this was also the basis for Davie's and Bendire's listings, I cannot say.

Eastern Kingbird

Tyrannus tyrannus (Linnaeus)

The kingbird is an uncommonly used host; only 15 actual instances have come to my notice. Several writers have listed it as a cowbird victim, possibly on the basis of the same few published cases. The actual records involve two races of the parasite, *ater* and *artemisiae*; the geographic spread of the records extends from Ontario, Rhode Island, and New York, to Ohio, Michigan, Iowa, Kansas, Nebraska, North Dakota, Montana, Saskatchewan, and Alberta.

The pugnacious disposition of the kingbird probably accounts for its relative freedom from the attention of the cowbird, but once the parasitic egg is laid in the nest, the kingbird takes care of it as do the other victims. Kells (1885) found young cowbirds in kingbirds' nests; Posson (1890) found a parasitized nest at Medina, New York; and Gregg (1891, p. 26) reported a kingbird feeding a young cowbird along with its own offspring in Chemung County, New York. A. J. Berger (1960, p. 118) near Ann Arbor, Michigan, on June 30, 1956, found a nest containing a young kingbird in pin feathers and a fully feathered young cowbird, which fluttered out of the nest at his approach but which remained in the nest after being banded. R. M. Anderson (1907, pp. 299, 300) wrote that in Iowa he found the kingbird to be the only species which "objected" to the cowbird, but he did not say exactly what he meant by this term. Possibly he was referring to Savage's (1897, p. 6) note of a parasitized nest from which the cowbird egg disappeared, presumably removed by the kingbird. Coues (1878, p. 608) recorded an instance of "objection" in his description: the two-storied nest of a kingbird, with a cowbird's egg buried in the lower part and 2 eggs of the kingbird on top, was found near Frenchman's River, Montana, July 9, 1874.

Western Kingbird

Tyrannus verticalis Say

This kingbird is in the present catalog solely on the strength of its inclusion in a compiled list of brown-headed cowbird victims in Oberholser's unpublished manuscript on the birds of Texas. No actual

cases or other data supporting its inclusion are on record but, judging from the geographical range of the western kingbird, the race of cowbird involved must be *artemisiae*.

Cassin's Kingbird

Tyrannus vociferans Swainson

I know of only a single instance of this species being used as a host by the brown-headed cowbird. A nest with 3 eggs of Cassin's kingbird and 2 of the dwarf race of the brown-headed cowbird was found in the Santa Rita Mountains, Arizona, June 29, 1884; it is now in the C. E. Doe collection in the Florida State Museum, Gainesville.

Scissor-tailed Flycatcher

Muscivora forficata (Gmelin)

The scissor-tailed flycatcher is a rarely imposed upon victim of the eastern and the dwarf races of the brown-headed cowbird. Fitch (1950, p. 158) found a nest in Brazos County, Texas, with 3 eggs of the scissor-tail and 4 of the dwarf race of the parasite. Before this, all that was known of the species as a molothrine host was the bare fact that Simmons (1925, p. 172) listed it as one of the birds parasitized in the region around Austin, Texas. In the files of the U.S. Fish and Wildlife Service are two unpublished records, both from Decatur, Texas, reported by John A. Donald in 1890 and 1892. Recently Pulich (1961, p. 52) recorded that on June 29, 1959, a scissor-tailed flycatcher was observed caring for a fledged cowbird in Tarrant County, Texas. This is the sole record for the nominate race of the cowbird using the species as a host. It would seem that by now a large enough number of nests of this flycatcher would have been found to give some idea of the frequency with which it is victimized. Since no other instances have been reported, it becomes evident that the species is seldom bothered by the cowbird. This is difficult to understand, as the South American counterpart, the fork-tailed flycatcher, *Muscivora tyrannus*, is a frequent host of the shiny cowbird, *M. bonariensis*, in Argentina.

Great Crested Flycatcher

Myiarchus crinitus (Linnaeus)

Like so many hole-nesting species, the great crested flycatcher is relatively unmolested by the brown-headed cowbird. Five records have come to my notice, two from Maryland, and one each from Massachusetts, Michigan, and Illinois. The data are as follows: the late J. Hooper Bowles informed me that once he had found a parasitized nest of this flycatcher in Massachusetts; Blocker (1936) listed it as a victim of the cowbird near Amboy, Illinois; E. J. Court (in litt.)

found a cowbird's egg in a nest of this flycatcher in Charles County, Maryland; Stewart and Robbins (1958, p. 329) mention two instances in Maryland, one of which is the E. J. Court record mentioned above; A. J. Berger (1960, p. 118) examined 11 nests near Ann Arbor, Michigan, during four summers of 1956–1959 and found that one of them was "parasitized" five days after it had been deserted. This nest was in one of a series of nesting boxes placed by Berger for the flycatchers. When using this type of box, the flycatchers would cover the entire floor with nesting material to the depth of an inch but would make the nest cup for the eggs at the rear of the box. The parsite did not lay her egg in the nest cup but on the nesting material halfway back from the entrance hole. Since the nest had been deserted by the time the cowbird layed in it, one may ask whether, in a strict sense, this is really an instance of parasitism on the crested flycatcher.

In all the above cases the race *boreus* of the host and the nominate race of the parasite are involved.

Eastern Phoebe

Sayornis phoebe (Latham)

The eastern phoebe is a very common victim of the brown-headed cowbird. Over 375 records have come to my attention, reports that range from Quebec, Massachusetts, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, and Virginia westward through Ontario, Manitoba, Saskatchewan, to Alberta; through West Virginia, Ohio, Indiana, Illinois, Michigan, Wisconsin, into Minnesota, Iowa, and Kansas. The records from Minnesota, Saskatchewan, and Alberta refer to the northwestern race of the cowbird, *M.a. artemisiae;* the others, to the nominate subspecies, *M.a. ater.* The degree to which the phoebe is affected varies locally. At Ithaca, New York, in my own field experience, out of 22 nests found, 16, or 75 percent of the nests, contained from 1 to 3 eggs apiece of the cowbird. At Amboy, Illinois, Blocker (1936, p. 133) reported 50 percent of the phoebes' nests had cowbirds' eggs in them. In southern Quebec, in Terrill's experience (1961, p. 3) the percentage of parasitism was 26 percent, out of 100 nests; in the neighborhood of Buckeye Lake, Ohio, Trautman (1940, p. 393) found that 9 out of 134 nests, or only 7 percent, were parasitized. In Kansas, Johnston (in litt.) informed me that 8 out of 79 phoebe nests, or roughtly 10 percent, were parasitized. In the Ithaca area, the first cowbird eggs of the season were found usually in phoebes' nests, and, until other species began nesting in numbers, this flycatcher was the chief host of the parasite. Later in the breeding season it was less frequently parasitized than it had been earlier. In southern Quebec, Terrill also noted that "early in the season, nests of the Phoebe may be the only

suitable ones . . ." and that some cowbirds seemed to show a trend toward host specificity on the phoebe "whether the nest site be shed, culvert, rock ledge, or sugar shanty, in the latter case often following the Phoebe deep into the woods."

Not infrequently the cowbird deposits an egg in a nest before the phoebe has laid any of her own, but this does not seem to affect the latter. In at least two cases wherein I knew the cowbird had laid first, the nest was not forsaken; the phoebe laid her clutch of eggs as though no strange eggs were present. On two other occasions, however, I found cowbird eggs partly buried in the bottom of the nest; in one case there were, in addition to the buried egg, another cowbird's egg and 2 phoebe's eggs on top. Bendire, years before (1895, p. 274), had also noted occasional attempts by the phoebe to bury the cowbird eggs under a new floor in the nest.

While some phoebe eggs are more or less speckled, most are unmarked white and, as such, they are in strong contrast to the darker, mottled eggs of the parasite. Crude experiments have been made to test the latitude of egg coloration tolerated by the phoebe; the result was that all of the eggs which were tried—from the larger, bluish-green eggs of the robin to the smaller, heavily dotted, cinnamon-reddish eggs of the house wren—were accepted and incubated, and, in the case of house wrens, were hatched and reared by the phoebes.

Black Phoebe

Sayornis nigricans (Swainson)

A single instance of the nominate race of this flycatcher as a host of the small, southwestern race of the brown-headed cowbird has come to my attention. E. A. Stoner (1938) found a nest about a mile and a half north of Manka, Solano County, California, on June 26, 1937; it contained 3 eggs of the black phoebe, 1 of the cowbird, and 3 of the western flycatcher. The nest was obviously built by the phoebe although at the time of discovery the western flycatchers seemed to be in charge of it. While there is no certainty that the parasitic egg was laid either before or after the change in ownership of the nest, it appears that it was deposited after the western flycatchers were in possession since there was a scanty lining of fine hairs over the phoebe's eggs, over which, in turn, were the eggs of the western flycatcher and of the cowbird. The case merits discussion here, nevertheless, because it involves the parasitism of the cowbird on the nest of a black phoebe in spite of the fact that the occupancy of the nest, in the meantime, had been taken over by another species. It recalls a case I came upon many years ago in Argentina wherein a shiny cowbird (*Molothrus bonariensis*) laid in the nest of a rufous ovenbird (*Furnarius rufus*) although the nest had been taken over by a tree toad.

Say's Phoebe

Sayornis saya (Bonaparte)

Six instances of brown-headed cowbird parasitism on Say's phoebe have been reported, five from Kansas and one from Oklahoma. All refer to the nominate race of the host and of the parasite. Two parasitized nests were found by Guy C. Love in Decatur County—one on May 30, the other on June 19, 1915—both of which were collected and eventually were incorporated into the J. P. Norris collection. On June 6, 1941, H. L. Heaton found another parasitized nest in the same part of Kansas. The fourth record, kindly sent to me by Dr. R. F. Johnston, concerns a nest with 3 Say's phoebe eggs and 1 of the cowbird, found at Concordia, Cloud County, May 13, 1951, by Dr. J. W. Porter. The fifth record reported a parasitized nest collected at Oberlin May 30, 1909, by L. R. Wolfe. The Oklahoma record was collected in Pawnee County, June 18, 1921; it is now in the collections of the Western Foundation of Vertebrate Zoology.

Without further data it is not possible to evaluate this flycatcher as a cowbird host; the paucity of records, however, is suggestive of the probability that Say's phoebe is not of much importance to the cowbird and that the latter, in turn, is not an important factor in the economy of the former.

Yellow-bellied Flycatcher

Empidonax flaviventris (Baird and Baird)

Rarely victimized or, at least, rarely reported as a cowbird victim, the yellow-bellied flycatcher is in our catalog on the strength of three parasitized nests found in Alberta—two by T. E. Randall and one by A. D. Henderson. The cowbird in all three cases is the subspecies *artemisiae*.

Acadian Flycatcher

Empidonax virescens (Vieillot)

In the more than 30 years since my first appraisal (1929, p. 209) of this flycatcher as a cowbird victim, only a small amount of additional data has come to light and these new records do not alter significantly the earlier findings. The Acadian flycatcher is generally an uncommon host though, at times and locally, it may be imposed upon rather frequently by the parasite. In Carroll County, Indiana, Everman (1889, p. 23) found it to be one of the chief hosts of the cowbird; and in Pennsylvania, Jacobs (1924, pp. 52–54) noted 12 instances. I have heard of some 59 records, an increase of only 34 in the 30 or more years since my 1929 compilation; they range from New England, New York, Pennsylvania, Maryland, and Virginia, westward to Ohio, Indiana, Illinois, Michigan, and Kansas. In the last-named state, Brandt (1947) described in considerable detail the

rearing of a young cowbird by a pair of these flycatchers. Occasionally the Acadian flycatcher may build a new floor over a cowbird's egg, especially if the parasitic egg is laid before any of the hosts' eggs are laid. Bendire (1895, p. 304) mentions such a case, which was found in Illinois by Loucks. All the records relate to the nominate race of the cowbird, *M.a. ater*.

In Michigan it has been the experience of Walkinshaw and others that, in nests of *Empidonax* (*virescens*, *traillii*, and *minimus*) which produce fledgling cowbirds, none of the young flycatchers survive. Walkinshaw (1961, p. 268) examined 67 Acadian flycatcher nests in southern and western Michigan; of these, 16, or 24 percent, were parasitized.

Traill's Flycatcher

Empidonax traillii (Audubon)

Both races of this flycatcher (*brewsteri* and *traillii*) are known to be victimized by the brown-headed cowbird, all three races of which are involved in the total number of records. In all, I have learned of over 150 instances of cowbird parasitism, in addition to several loose statements which implied still other cases. The records range from British Columbia, Saskatchewan, and Ontario to southern Quebec in Canada; and from New England to Ohio, Illinois, Michigan, Wisconsin, Minnesota, Iowa, Colorado, New Mexico, Washington, and California in the United States. The largest number of records comes from southern California (41 cases), but it is not known what percent of the total number of nests found by the observers is represented by this figure. This flycatcher also appears to be a somewhat commoner victim in the Nipawin area of Saskatchewan than in many other areas, according to the experience of M. G. Street (1943, p. 7), who states that he has seldom found an unparasitized nest of this species. In Ohio, Hicks (1934, p. 386) noted that, of 108 nests found, 23, or 21 percent, were parasitized; in Michigan, Berger and Parmelee (1952, p. 37) found that the ratio of parasitized nests was 20.8 out of 48 nests observed; in the next eight summers, Berger observed 216 nests, of which 17, or 8 percent, were parasitized. Walkinshaw (1961, p. 268) found that 4 out of 53 Michigan nests were parasitized. At Buckeye Lake, Ohio, Trautman (1940, p. 296) found cowbird eggs or young in 9 out of 16 nests, or over 50 percent. In Wisconsin, McCabe (in litt.) found 418 nests of this flycatcher during a period of 17 years. Of these, 29, or 6.9 percent, were parasitized. The incidence of parasitism varied from year to year, ranging from 3 to 10 percent of the nests examined. If we add the results of these 6 studies (Hicks, Berger, Walkinshaw, Parmelee, Berger, Trautman, and McCabe) made in Ohio, Michigan, and Wisconsin, we get a total of 859 nests, of which 92, or almost 11 percent, were parasitized.

In Colorado, Bendire (1895, p. 307) found "several" parasitized nests; King (1954, pp. 150–154) noted two instances in Whitman County, Washington. In southern Quebec, Terrill (1961, p. 4) found cowbird eggs in 9 out of 146 nests of this flycatcher, a percentage of 6.2. He felt that the rather late nesting of this bird may have accounted for the low frequency of parasitism.

In Whitman County, southeastern Washington, an area where the cowbird was not very abundant, King (1955) found that the hatching success of eggs of this flycatcher was very high—84 percent in 1952, 98 percent in 1953. In the latter year, fledging success was 44.6 percent. These figures suggest that Traill's flycatcher is a species readily able to survive a considerably greater frequency of cowbird parasitism than our present compilation indicates.

J. K. Cruttenden (in litt.) writes me that he has a remarkable set of 4 eggs of Traill's flycatcher with one of the brown-headed cowbird, taken in Cook County, Illinois, July 5, 1947. The nest was constructed in three sections: the cowbird egg was in the lowest section; a new floor had been built over it and in this the flycatcher had laid an egg, and then for some unknown reason she had built another floor, this time over her own egg, and had laid 3 more eggs in the new nest above. Cases of flooring over cowbird eggs, with or without one or more eggs of the host, are well known for the yellow warbler and several other birds, but this appears to be the first such instance recorded for this flycatcher.

Least Flycatcher

Empidonax minimus (Baird and Baird)

The least flycatcher appears to be molested rather seldom by the brown-headed cowbird. I have noted only 19 records in all, distributed from Quebec, New England, New York, Pennsylvania, and Maryland to Michigan, Iowa, Utah, North Dakota, Montana, Alberta, and British Columbia. These records involve two races of the parasite, *ater* and *artemisiae*. The old statement in the literature by Baird, Brewer and Ridgway (1874, pp. 154–157) that this is one of the commonest victims in New England strangely is unsupported by subsequent observations, and what records they may have had have similarly not appeared in print. In Michigan, Walkinshaw (1961, p. 268) found that this species was victimized less frequently by the parasite than was either the Acadian or Traill's flycatcher.

Western Flycatcher

Empidonax difficilis Baird

Six cases of cowbird parasitism on the western flycatcher have come to my notice, all from California and all concerned with the

southwestern subspecies of the parasite, *M. a. obscurus*, together with the nominate race of the host. These records are: a set of 2 eggs of the flycatcher and 1 of the dwarf race of the cowbird, collected on May 12, 1941, in Santa Clara County, California, by G. Brown, Jr., and now in the R. Kreuger collection, Helsinki, Finland; a fledgling cowbird seen by Legg to be attended by and fed by a western flycatcher at Point Lobos, California, July 15, reported by Pray (1952, p. 298) and later by Legg (1954, p. 314); a nest containing 1 egg each of the host and of the parasite, found at Eel River Bar, Humboldt County, California, in June 1941, by R. R. Talmadge (1948, p. 273); a fledged dwarf cowbird attended by a western flycatcher at Berkeley, noted by Benson and Russell (1934, p. 219); a nest with 2 eggs of the host and 1 of the parasite, found near Gilroy, April 28, 1932, by Eschenberg (Friedmann, 1943, p. 353); and two other parasitized nests reported in another paper (Friedmann, 1943, p. 353), one found near Gilroy, April 28, 1932, by Eschenberg and one at Betebel by Unglish.

A possible seventh instance, reported by E. A. Stoner (1938), concerns the nest of a black phoebe, taken over apparently by a pair of western flycatchers a nest which, when found, contained 3 eggs of each of the two birds plus 1 of the cowbird. This instance is discussed under the black phoebe. Unknown as a cowbird host until 1934, the western flycatcher appears to be in process of becoming a fairly regular victim in California, where the parasite is extending its range.

Eastern Wood Pewee

Contopus virens (Linnaeus)

The wood pewee is a fairly regular but not a favorite host of the brown-headed cowbird. In my 1929 summary (p. 209) I knew of about three dozen instances; in over 30 years since then, I have noted only two dozen more. While these probably represent only a portion of all the cases which have been found, the fact remains that, in some areas where both the wood pewee and the cowbird are common breeding birds, no such records have been reported. Stewart and Robbins (1958) do not include the wood pewee as a molothrine host in Maryland and the District of Columbia; similarly, there are no records for this flycatcher in the extensive host lists of the annual surveys of the Detroit region which the Detroit Audubon Society made from 1952 through 1954. The records culled from the literature, from museum collections, and from correspondence range from Massachusetts, Connecticut, New York, New Jersey, and Virginia westward to Ohio, Indiana, Illinois, Michigan, Iowa, and southern Ontario. All have to do with the eastern race of the cowbird. As many as 4 cow-

bird eggs have been reported from a single nest of this species (Greene, 1917, pp. 193–194).

Western Wood Pewee

Contopus sordidulus Sclater

The western wood pewee is known to be parasitized by two races of the brown-headed cowbird, *obscurus* and *artemisiae*—both, however, on the basis of very few records. The race *obscurus* is involved in a parasitized set of eggs taken at Prescott, Arizona, May 31, 1891, as recorded by Bendire (1895, p. 293), and in another set, collected by Stephen Barlow "in California" (probably near San Diego). The race *artemisiae* is involved in four records of parasitized nests found in Alberta by T. E. Randall, and one nest found at Trout Creek Point, British Columbia, by E. M. Tait. In all of these cases the subspecies of the pewee is *C.s. veliei* Coues.

Olive-sided Flycatcher

Nuttallornis borealis (Swainson)

The olive-sided flycatcher is a rarely reported victim of the brown-headed cowbird (race *M.a. artemisiae*). I know of three records—two from Alberta and one from California. Each of the Alberta records involves a nest with 3 eggs of the flycatcher and 1 of the parasite, one nest found near Belvedere, June 27, 1925, by A. D. Henderson; the other, at Boyle, June 7, 1934, by T. E. Randall. The third record involves a nest with 2 eggs of the host and 1 of the parasite, taken at June Lake, Mono County, California, June 19, 1952, by J. B. Dixon, and now in the R. Kreuger collection in Helsinki, Finland. I am indebted to Mr. Kreuger for the data on this set.

Vermillion Flycatcher

Pyrocephalus rubinus (Boddaert)

This flycatcher is an uncommonly reported host of the small, southwestern race of the cowbird, *M. a. obscurus*, but there is reason to believe that it is parasitized more frequently than the records indicate. Two races of the vermillion flycatcher are involved—*P.r. flammeus* in Arizona and California and *P. r. mexicanus* in the lower Rio Grande valley of Texas. Near Brownsville, Texas, J. C. Merrill (1878, p. 142) found a parasitized nest on May 10, 1877; Bendire (1895, p. 324) found two such cases in southern Arizona; other Arizona records have come since from Nogales (Dille, 1940, p. 87), from Phoenix (A. M. Ingersold), and from Tucson (N. K. Carpenter). In the collections of the Santa Barbara Museum of Natural History there is a set of 3 eggs of the vermillion flycatcher with 1 of the dwarf cowbird which was collected south of Tucson, Arizona, June 2, 1917.

W. J. Sheffler informed me that he had noted many instances of cowbird parasitism on this flycatcher in Arizona. Hanna (1936, p. 174) recorded two parasitized nests from Coachella Valley, Riverside County, California.

Horned Lark

Eremophila alpestris (Linnaeus)

The horned lark is an infrequent victim of the brown-headed cowbird, but at least three of the lark's geographic forms are known to have been imposed upon by the parasite—*enthymia*, *practicola*, and *leucolaema*. Two races of the cowbird, *ater* and *artemisiae*. are involved. Of the race *enthymia* there is one record—a parasitized nest found at Cypress Hills, Saskatchewan, June 8, 1920, by S. J. Darcus. Of *leucolaema* there are two records—one found in Alberta by T. E. Randall and one from Fergus County, Montana, reported by W. Raine (1894, p. 120). The subspecies *practicola* is the only one for which there are a fair number of records—14 definite ones and an indefinite number of others which are referred to loosely by such statements as "locally commonly parasitized" around Grant Park, Illinois (A. E. Price, in litt.), or "I often find one or more eggs of the cowbird in the nests of this species" in Marshall County, Iowa (A. P. Godley, *in* Savage, 1895, p. 34). Although it can be authenticated that in some places the horned lark is a fairly frequent host, Pickwell (1931, pp. 106–109) found, out of 32 nests under observation in Illinois and New York, only one which was parasitized. Moreover, in the annual nesting surveys of the Detroit Audubon Society, numerous horned lark nests are reported each year but none have been found which contain cowbird eggs or young. Price (1934, p. 107) noted two parasitized nests at Payne, Ohio, but he considered it very unusual to find cowbirds' eggs in horned larks' nests. Williams (1950, p. 153) listed the prairie horned lark as a cowbird host in the Cleveland, Ohio, region. Apparently, there must be considerable local variation in the frequency of cowbird parasitism of this victim. The above records come from southern Quebec, Ontario, Ohio, Illinois, Iowa, Wisconsin, Kansas, and Minnesota. At Lake Crystal, Minnesota, Peabody (1899, p. 118) found 2 cowbird eggs in the same nest of a horned lark; at Loganville, Wisconsin, Robbins (1949) reported a nest with 4 cowbird eggs and 2 of the host; all the other records involved single eggs.

Generally speaking, the cowbird does not lay to any extent in nests of the horned lark. Pickwell pointed out that, in Illinois and in some other areas, more than half of the lark's breeding season is over before that of the cowbird begins. He suggested that the early nesting time, the exposed nature of the nest and the habitat, as well as the early termination of the nestling period (10 days) may mitigate also

against successful parasitism by the cowbird. Experimentally he found that the lark will tolerate strange eggs or young in the nest and that in the second half of the lark's breeding season, the food supply is adequate and ample; thus it appears that other factors, as yet undetermined, operate against the occurrence of cowbird parasitism. In a period of many years in southern Quebec, Terrill (1961, p. 4) found 201 nests of the horned lark and, of these, only 3 were parasitized.

Tree Swallow

Iridoprocne bicolor (Vieillot)

The tree swallow is a rarely imposed upon victim but one which, Kumlien and Hollister (1903, p. 105) wrote, "often becomes the foster parent of the cowbird" in Wisconsin. Still earlier, also in Wisconsin, F. L. Grundtvig (1894, p. 122) wrote of having seen a female brown-headed cowbird looking into the nest of a tree swallow on May 28 and, on July 19, of seeing five young cowbirds among a large flock of young tree swallows. More recently, Robbins (1947, p. 135) reported a nest with 7 eggs of the swallow and 1 of the cowbird, found on June 13, 1947, by Carl Richter in Oconto County, Wisconsin. Years ago I suggested (1929, p. 234) that, if the brown-headed cowbird parasitizes tree swallows in Wisconsin to any extent when it still is not known to do so elsewhere, the case might be that the swallows there used shallower and wider-mouthed nesting cavities (possibly nest boxes) than in other areas; however, this is not known to be so. It is strange that every one of the few records should come from a single area, especially since the tree swallow is not parasitized in the remainder of its ranges. The parasite in all these cases is the eastern form, *M.a. ater*.

Bank Swallow

Riparia riparia (Linnaeus)

The bank swallow is an unusual and unlikely victim of the brown-headed cowbird. There is one record. In the R. M. Barnes collection, presumably now in the Chicago Natural History Museum, is a parasitized set of 6 eggs of the bank swallow and 1 of the cowbird (race *M.a. ater*), collected in Illinois by W. E. Loucks. This record involves the nominate race of the host.

Barn Swallow

Hirundo rustica Linnaeus

The barn swallow is a very infrequent victim. The known instances are as follows: Anderson (1907, p. 299) listed it as a cowbird host in Iowa, a listing which he based on the record of a parasitized nest found by J. V. Crone and originally reported by Savage (1895, p. 36); a parasitized set, consisting of 4 swallow eggs and 1 cowbird egg, col-

lected at La Anna, Pennsylvania, June 30, 1914, was in the collection of the late J. Hooper Bowles; Poole (1930, p. 41) wrote that in Berks County, Pennsylvania, two parasitized nests of this swallow had been reported; Wells (1934, p. 130) found "several" parasitized nests at Colony, Kansas. A fifth instance of the barn swallow as a cowbird host has been noted in Maryland by Stewart and Robbins (1958, p. 329). The exact data, for which I am indebted to R. E. Stewart, is that a nest containing 1 egg of the swallow and 1 of the cowbird was found in St. Mary's County, Maryland, May 30, 1932. All of these cases involve the nominate race of the parasite and the subspecies *erythrogaster* of the host. What might have become still another instance was observed at North Eastham, Cape Cod, Massachusetts, by O. L. Austin (1932): a female cowbird was seen trying to enter the nest of a barn swallow but was driven off by the pair of swallows.

Cliff Swallow

Petrochelidon pyrrhonota (Vieillot)

Of all the swallows in the present catalog, this one, because of the difficulties of entrance imposed by the narrow openings of its retort-shaped nests, seems the least likely to be parasitized by the brown-headed cowbird. At La Anna, Pennsylvania, however, on June 30, 1914, three nests were found with cowbirds' eggs in them, according to the late J. Hooper Bowles (in litt.), who acquired one of these sets for his collection. Poole (1930, pp. 41, 50) recorded four parasitized nests of the cliff swallow in Berks County, Pennsylvania. Many years earlier, Poling (1890, p. 92) mentioned a cowbird's egg found in a cliff swallow's nest near Chicago by George L. Tappan. This is probably the basis for Bendire's inclusion of this species in his list of cowbird hosts. It is the same record that I erroneously mentioned (1929, p. 234) as being by an unsigned, and hence anonymous, observer. The above records all refer to the eastern race of the parasite, *M.a. ater.*

Purple Martin

Progne subis (Linnaeus)

The purple martin has never been reported in print as a cowbird host. One record, which has been in my files for many years, should be reported now. In 1929 Mr. C. A. Barnum of Detroit, Michigan, wrote me that he had built a martin house and placed it on a pole about 20 feet high. When the martins nested in it, he noted that brown-headed cowbirds often came and entered nest compartments for a few moments at a time. He was unable to get up to the nests to examine them, but on several occasions he found broken cowbird eggs around the base of the pole. He did not observe any fledgling cowbirds later with the martins. The fact that he saw cowbirds enter the nest

compartments and the fact that later he found broken cowbird eggs on the ground below certainly suggest that the eggs were deposited in the nests and then subsequently ejected. Because Mr. Barnum actually had not seen the cowbird eggs in the martin nests, I have withheld this record for many years. Inasmuch as no additional instances of the cowbird parasitizing the purple martin have come to my notice since then, I can assume only that this swallow is molested rarely by the parasite but that such a situation did occur at the time of the original observation. The nominate races of both the swallow and the cowbird are involved here.

Blue Jay

Cyanocitta cristata (Linnaeus)

The blue jay is an uncommon victim quite unsuitable as a potential fosterer for a brown-headed cowbird. The eggs of the former are so much larger than those of the cowbird that any eggs of the latter in a nest would hardly have sufficient contact with the body of the incubating host to allow them to develop and hatch. There are a few records, which can be listed as follows: Blocher (1933, p. 58; 1936, p. 132) found the blue jay to be parasitized at Amboy in northern Illinois; in the first of his two papers he reports a nest on May 22, 1932, containing 4 eggs of the jay and 1 of the cowbird; in the second paper he records what appears to be a similar instance in 1934, in the same locality, but his wording is too inexact not to rule out the possibility that both refer to the same case; F. B. Webster (1890, p. 31) stated that he had a parasitized set of blue jays' eggs in his collection but gave no details; finally, the late T. S. Roberts (in litt.) informed me many years ago that he had a distinct recollection of finding, at least once, the egg of a cowbird in the nest of a blue jay. The eastern race of the parasite, *M.a. ater*, and the northern race of the jay, *C.c. bromia*, are the forms involved in all of these records.

Common Crow

Corvus brachyrhynchos Brehm

One indefinite record of this unexpected host—unfortunately without details—should be mentioned here. In Feathers, the journal of the Schenectady Bird Club, in the issue of February 1941 (p. 15), there is given a list of "cowbird-raisers" in the vicinity of Buffalo, New York. Among the 41 listed species is the crow. The statement is made that all of the species listed are in "the records of the Buffalo Ornithological Society." Some years ago, however, the late James Savage tried in vain to find anything further about the basis for the inclusion of the crow in the list. While it obviously is possible that a brown-headed cowbird, with an egg ready to be laid, may be forced

by circumstances to use an unlikely but available nest, such a record means no more than a record of the accidental occurrence of a bird outside its usual range. The fact that the crow was listed as a "cowbird-raiser" cannot be taken as evidence that it reared a young cowbird; the most that can be assumed is that an egg of the latter was found in a crow's nest. The geographical location of the "record" implies that the cowbird involved was typical *ater* and the crow, typical *brachyrhynchos*.

Black-capped Chickadee
Parus atricapillus Linnaeus

The black-capped chickadee is a rarely imposed upon victim. Out of many hundreds of nests reported on, only four instances of parasitism by the brown-headed cowbird have come to my notice—from Iowa, Massachusetts, and Michigan. Goelitz (1915, p. 152) found a nest with 4 eggs of the chickadee and 1 of the brown-headed cowbird at Ravina, Illinois, May 8, 1915. The record as published specified the Carolina chickadee but, on geographic grounds, the bird is much more likely to have been the black-capped species. Blocher (1936, pp. 131–133) found it to be parasitized at Amboy, Illinois. Packard (1936) found a nest on May 25 at North Eastham, Cape Cod, Massachusetts, containing 4 eggs of the chickadee and 2 of the cowbird. On June 6 the 2 cowbird eggs hatched and 1 chickadee egg was missing. Two days later 2 chickadee eggs hatched but 1 young chickadee was dead. On June 10 the second young chickadee was missing; the other egg of the host never hatched. That same date the young cowbirds were removed for parasitological study. Recently, one other record of this unusual fosterer has been reported. Nickell (1956, p. 136), in a willow stump in southeastern Michigan, found a nest in which a cowbird egg had been laid about 13 inches from the entrance on a narrow ledge of rotten wood, which was just broad enough to prevent it from rolling off. This egg was laid on June 12, 1952, at a time when the nestling chickadees were already 10 days old; thus it almost certainly would have been abandoned and not hatched by the chickadees. In Nickell's discussion of the few instances of cowbird parasitism of this bird, he states that this was the only parasitized nest he had discovered, out of 38 nests observed during 14 years of study in the area. However, in the 1952 survey of the area, the Detroit Audubon Society (1953, p. 70) lists a nest containing 5 eggs of the black-capped chickadee and 1 of the cowbird which had been found by Nickell at Cranbrook. In spite of the discrepancy, I am convinced that these refer to the same instance.

All of the above records involve the nominate races of both host and parasite.

Carolina Chickadee

Parus carolinensis Audubon

This species parallels the black-capped chickadee in its relation to the brown-headed cowbird. The similarity in appearance and in habits of the two chickadees probably reduces them to a single entity as far as the parasite is concerned. Only two records have come to my notice, both from Maryland and both recorded by E. J. Court: a nest with 5 eggs of the host and 2 of the cowbird, collected at Piney Point, St. Mary's County, April 25, 1934, and another with 5 eggs of the chickadee and 1 of the cowbird in the same area on May 25, 1934. In the case of the first record, Court informed me that he caught the female cowbird on the nest about half an hour after daylight. Stewart and Robbins (1958, p. 329) list only the second record, a circumstance which raises the question as to whether or not the two records may be really a single instance with an error in reporting. The nominate race of the cowbird and the subspecies *extimus* of the chickadee are involved here.

Tufted Titmouse

Parus bicolor Linnaeus

The tufted titmouse is an uncommon victim of the brown-headed cowbird, but it has been noted in that capacity in Pennsylvania, Ohio, and Illinois. In Bendire's early list (1893) of cowbird victims, he included this species, but what evidence he had is not clear. Ogilvie-Grant (1912, p. 374) listed a cowbird's egg in the British Museum, an egg reported to have been taken from a tufted titmouse's nest by P. M. Whealer, but no date or locality was given. Goelitz (1915) recorded two parasitized nests in Illinois, one containing 7 eggs of the host and 1 of the parasite, the other with 3 eggs of the titmouse and 2 of the cowbird. Jacobs (1888, 1823) noted a parasitized nest in Pennsylvania on May 7, 1887, early enough to have been the basis for Bendire's inclusion. Price (1934) found another at Sherwood, Ohio. Sutton (1928, p. 163) discovered a tufted titmouse that was parasitized on one occasion in the Pymatuning Swamp area, Pennsylvania. All the records relate to the eastern race of the parasite, *M.a. ater*.

Black-crested Titmouse

Parus atricristatus Cassin

One subspecies of this titmouse, *P.a. sennetti*, has been recorded as a victim of the dwarf race of the brown-headed cowbird. A. J. Kirn informed me some years ago that once at Somerset, Texas, he collected a set from this bird with 2 of its own eggs and 1 of the cowbird's. He wrote that evidently there had been a disturbance at the nest: one of the host's eggs was punctured, the nest was some-

what disarranged, and it had been deserted. This is the same instance mentioned by Bent (1946, p. 191) and by me in another paper (Friedmann, 1949, p. 158). Apart from this one case, the only other record is that of Simmons (1925, p. 172) in his list of cowbird victims for the Austin, Texas, region.

Verdin

Auriparus flaviceps (Sundevall)

The eastern race of the verdin, *A.f. annexus*, has been reported on a few occasions as a victim of the dwarf race of the brown-headed cowbird. At Brownsville, Texas, in May 1924, I found five nests of this little bird, one nest of which contained an egg of the parasite as well as 4 of the host. The entrance to the nest was larger than the entrances of the others; it may have been disarranged somewhat by the cowbird when attempting to enter the nest. R. W. Quillin wrote me many years ago that he had found a few similarly parasitized nests, all of which were in poor condition, with the neck or entrance torn away, and all of which were deserted.

Bush-tit

Psaltriparus minimus (Townsend)

Two races of this bird, one of the smallest victims of the dwarf race of the brown-headed cowbird, have been found to be parasitized in California—the coastal form *minimus* and the inland race *californicus*. Bradford (1928) at Rincon, Riverside County, June 24, 1926, found a nest of 2 eggs with 1 cowbird egg partly buried under a new nest lining. This record I referred to *californicus* (1929, p. 256) but, on the basis of present knowledge of the ranges of the races of the bush-tit, the report seems to be allocated better to *minimus*. H. W. Carriger informed me that he found a parasitized nest of *minimus* at Irvington, Alameda County, May 15, 1932, containing 8 eggs of the host, 2 of which were punctured, and 1 of the parasite. Of the race *californicus* there is the following record: Ashworth (1930a, p. 43; 1930b, p. 122) found a nest in Ventura County, March 29, containing 7 eggs of the host, 1 of which was partly buried under the feather lining of the nest, and 1 egg of the dwarf cowbird.

White-breasted Nuthatch

Sitta carolinensis Latham

As might be expected from its habit of nesting in holes, this bird rarely is parasitized. Only five records have come to my attention—three from Pennsylvania, one from Illinois, and one from New York. In the last state, Reinecke (1912, p. 536) found a parasitized nest near Buffalo. In Pennsylvania, two of the records were made at State College by R. C. Harlow, one on May 16, 1910, and one on

May 5, 1912. The other instance was found by Jacobs (1923, pp. 19–20), presumably near Waynesburg. All four records involve the subspecies *cookei* of the host and the nominate race of the parasite. The Illinois set, taken in Knox County, May 12, 1942, by H. M. Holland, is now in the egg collection of R. Kreuger, to whom I am indebted for the data.

Red-breasted Nuthatch

Sitta canadensis Linnaeus

This species is a recent addition to the list of parasitized birds, and it is one that is not likely to be molested frequently by the parasite. Houston and Street (1959, p. 176) list the red-breasted nuthatch as a victim of the brown-headed cowbird (subspecies *artemisiae*) at Nipawin in the valley of the Saskatchewan River, Saskatchewan. When the nest first was found, apparently it did not contain a cowbird's egg. At that time the opening was enlarged to allow the observer to reach inside and then the "portion that had been removed was replaced. Later it was noted that the replaced portion had fallen away and the nest was now found to contain an egg of the cowbird in addition to those of the Nuthatch." The logical question arises, therefore, whether or not the cowbird would have used, or would have been able to use, this nest for its egg were it not for the enlargement of the opening; and thus the question remains as to whether or not this bird legitimately can be considered a natural host of the parasite.

Brown Creeper

Certhia familiaris Linnaeus

A single instance of cowbird parasitism on the brown creeper has been reported. Kumlien and Hollister (1902, p. 124) noted that at Meridan, Wisconsin, late in June, 1897, J. N. Clark observed a pair of brown creepers feeding a recently fledged cowbird. Since noisy young cowbirds occasionally attract the attention of food-laden birds in addition to their own foster-parent, one may ask if Clark's observation constitutes a definite record of parasitism. Because of this and also because most nests of the creeper would be inaccessible to the parasite, an element of doubt cannot be eliminated—although the probabilities are that the creepers were the actual fosterers. The subspecies *americana* of the host and the nominate race of the parasite are involved here.

Wrentit

Chamaea fasciata (Gambel)

Two races of this little bird have been found to be victimized by the small southwestern race of the brown-headed cowbird. The records rest upon five occasions, all in California. Four of these instances concern the pallid subspecies *C.f. henshawi*. M.C. Badger informed

me that he once found this bird victimized at Santa Paula on June 13, 1917, when he collected a set of 1 egg of the victim and 1 of the parasite. These eggs later went to the collection of the late J. Hooper Bowles. In the collections of the Western Foundation of Vertebrate Zoology there is another set: 4 eggs of the wrentit and 1 of the dwarf cowbird, taken at Santa Paula on May 8, 1936. Rowley (1930, p. 131) put on record a similar instance of cowbird parasitism in the San Gabriel River district, May 8, 1927, with a nest containing 3 eggs of the wrentit and 1 of the cowbird. Mr. N. K. Carpenter wrote to me of still another instance. In a record from Inverness, Marin County, Williams (1957, p. 428) reported that on July 22 one of these wrentits was seen attending and feeding a recently fledged cowbird. This last record refers to the race *rufula* of the host.

House Wren

Troglodytes aedon Vieillot

The house wren is parasitized very infrequently, partly because of its habit of nesting in holes and partly because of its pugnacious nature, which may be a deterrent to visiting cowbirds. An unexplained mystery, however, is involved here: the South American house wren, *T. musculus*, with essentially similar habits, is imposed upon far more often by the shiny cowbird, *Molothrus bonariensis*.

Only six actual instances, distributed from Ontario, New York, Michigan, and Iowa, to North Dakota and Alberta, have come to my attention. A few authors, such as Bendire and Davies, have included the house wren in their lists of cowbird victims, but without any supporting data. The cases known to me are as follows. Kells (1885, p. 106) found the race *baldwini* of the wren to be parasitized near Listowel, Ontario, in 1884. Alfred Eastgate informed me many years ago that he once found an egg of the cowbird (subspecies *artemisiae*) in a nest of the western race of the wren (*T. a. parkmanii*) in North Dakota. Later, T. E. Randall sent me a second record for the western house wren, involving a nest with 5 eggs of the wren and 1 of the cowbird taken at Boyle, Alberta, June 10, 1934. Finally, on July 12, 1947, James Hodges saw a pair of western house wrens feeding a recently fledged brown-headed cowbird at Duck Creek, Scott County, Iowa. In this instance I deduce, on geographic grounds, that the parasite must have been of the nominate race, *M.a. ater*. Hamerstrom (1947) noted a house wren feeding a recently fledged cowbird in Michigan. In this case there was some question as to whether or not the young cowbird came from an earlier brood, as at the time the only pair of wrens present had a nest with eggs. The cowbird might have been reared by some other species, and, as a result, the observation involved only its begging from and being fed by a wren.

Evidence of still another instance of a young cowbird being reared by a house wren is afforded from a photograph of such an incident, probably in New York State, taken by A. A. Allen and reproduced in Armstrong (1955, opp. p. 217, fig. b).

Of comparative interest is the fact that the European wren (*Troglodytes troglodytes*)—a species more like the North American winter wren (*T. hiemalis*) than it is like the house wren, but yet not too dissimilar in habits—is parasitized frequently by the European cuckoo, a bird larger than the cowbird. Armstrong (1955, pp. 240–242) concluded that, in Britain, wrens' nests are parasitized occasionally, apparently only when the nests of other fosterers are not available, but he noted that there were numerous records from continental Europe. As he stated, "it would be difficult to believe that the popularity of the wren with the cuckoo as a fosterer had not been exaggerated did not the evidence of so many authorities concur." In Germany, on more than one occasion, as many as three cuckoo eggs have been reported from a single wren's nest.

Bewick's Wren

Thryomanes bewickii (Audubon)

Bewick's wren is an infrequent victim. Only six actual instances, involving three races of the wren and two of the parasite, have come to my notice. Of the nominate *T.b. bewickii*, there is a single record, from Missouri, where Nehrling (1893, p. 244) found a brown-headed cowbird's egg in this wren's nest, which was in a nest box he had provided. He noted that "the entrance hole was very small so that no Bluebird and not even the Tufted Titmouse could enter. Nevertheless the cowbird deposited its egg in the nest." Henninger (1902, pp. 400–401) found a parasitized nest of the subspecies *T.b. altus* in southern Ohio, containing 5 eggs of the Wren and 1 of the parasite. The other four records refer to the Texas race *T.b. cryptus* and the dwarf form of the brown-headed cowbird, *M.a. obscurus*. R. W. Quillin wrote to me many years ago that in the summer of 1925 he collected two sets of eggs, each containing 5 eggs of the wren and 1 of the cowbird. In both cases the wrens were flushed from the nest. Quillin previously had found cowbird eggs in a number of this wren's nests but they were deserted and in most cases did not contain any eggs of the wren. All the nests used by the parasite were in holes that had been broken or otherwise enlarged so that the rim of the nest was visible. Recently, Mr. E. J. Court sent me a card written at San Angelo, Texas, in April 1954, by Fred Nyc, describing an incomplete set, which comprised 2 eggs of the host and 1 of the cowbird. The nest was in a cavity in a rotten stump eight feet above the ground; the cowbird egg was on the rim of the nest about four

inches inside the hole, a factor which suggested to the collector that the parasite may have been unable to enter very far into the nest cavity. Nyc (in litt.) wrote to me about yet another parasitized set he collected in Texas, containing 5 eggs of the wren and 1 of the cowbird.

Carolina Wren

Thryothorus ludovicianus (Latham)

The Carolina wren is an uncommon victim in most parts of its range, but apparently less so in Oklahoma than elsewhere. All of the records involve the nominate subspecies of the wren and all but one, the eastern form of the parasite. The known instances are as follows. Dickey (1914, pp. 158–160) records four parasitized nests in southwestern Pennsylvania, one, "found April 22, 1905, was built behind some overhanging sod, in a bank bordering a public road. . . . The bird laid but three eggs when a cowbird deposited one of hers. . . . April 24, I found a nest built in a depression of the sod, at the base of an old apple sprout, which grew on a bank at the roadside. The female incubated three eggs of her own and one of the cowbird's. Some years later two more nests of this wren, containing eggs of the cowbird, came under my observation." Jacobs (1924, pp. 52–54) describes another case, also from Pennsylvania. The late R. M. Barnes wrote to me that he had a set of eggs from this wren with a brown-headed cowbird's egg, but he gave no locality. Nice (1931, p. 136) lists four parasitized nests from Copan and Vinita, Oklahoma, these four comprising one-fourth of all the nests of this species found there. At Radnor Lake, near Nashville, Tennessee, on July 9, 1933, Crook (1934) found a nest containing 3 eggs of the Carolina wren and 1 of the cowbird. Johnston (in litt.) informed me that, of 11 nests found in Kansas, 2 were parasitized by the brown-headed cowbird. In the vicinity of Austin, Texas, Simmons (1925, p. 172) listed the Carolina wren as a local victim of the dwarf race of the cowbird, *M.a. obscurus*. Pulich (1961, p. 60) reported the same thing, possibly on the basis of Simmons' statement.

Rock Wren

Salpinctes obsoletus (Say)

The rock wren has been recorded as a brown-headed cowbird host in Kansas and in Colorado. The Colorado instance, recorded by Bendire (1895, p. 437) on information received from W. G. Smith, refers to the western race of the parasite, *M.a. artemisiae;* this record remains the sole case for the subspecies. In Kansas the eastern, nominate race of the cowbird is the breeding form. In that area L. R. Wolfe wrote to me that he collected a set of 4 eggs of the wren and 2

of the cowbird on June 17, 1914. Herr Schonwetter informed me that he has in his collection a parasitized set taken in Kansas, May 12, 1913, and Mr. Guy Love wrote to me that he had collected no less than twelve parasitized sets in Decatur County, where Col. Wolfe had obtained his set. It appears from this that the rock wren (nominate race) must be a fairly frequent victim in Kansas.

Mockingbird

Mimus polyglottos (Linnaeus)

The mockingbird is molested by the brown-headed cowbird infrequently, in sharp contrast to the situation in Argentina where the several species of the genus are among the regular hosts of the shiny cowbird. Both the eastern and the western subspecies of the mockingbird have been reported as victims, and two races of the cowbird, *ater* and *obscurus*, are involved in the several records, which come from Maryland, Arkansas, Kansas, Oklahoma, and Texas. The actual records are as follows. E. J. Court informed me that he once found a parasitized nest in St. Mary County, Maryland. This and one other Maryland record are noted by Stewart and Robbins (1958, p. 329). Plank (1919, p. 18) found a similar case near Decatur, Arkansas. According to R. F. Johnston (in litt.), of 49 nests found in Kansas, 1 was reported as having a cowbird egg in it. Nice (1931, p. 138) lists another instance, discovered by T. R. Beard at Sapulpa, Creek County, Oklahoma. This record is the same as one which earlier and tentatively I had allocated (1929, p. 252) to the western race of the host, *M.p. leucopterus*, but it turns out that the nominate eastern race is the form involved. The western race is, however, the one recorded as a cowbird victim in McLennan County, Texas, by Oldright (1890a, p. 58) and at Austin, Texas, by Simmons (1925, p. 172). Oldright (1890b, pp. 33, 34) writes that dwarf cowbirds' eggs seldom are found in mockingbirds' nests but that in 1890 several were found. E. J. Court informed me that he once found a parasitized nest near San Antonio, Texas.

Catbird

Dumetella carolinensis Linnaeus

This bird is an infrequently used host and one with which the cowbird is generally unsuccessful because, in the majority of cases, the catbird throws out the cowbird's eggs. Many years ago at Ithaca, New York, I conducted some crude experiments to see whether or not this reaction of the catbird was correlated with ability to distinguish its own eggs from those of other birds, specifically those eggs differing in coloration and in size from its own. House sparrow and chipping sparrow eggs were placed in two catbird nests, and in each

case both kinds of eggs were ejected by the catbirds. More recently, I have tried the same experiment with a robin's egg and a mourning dove's egg, and again the catbird threw them out while, at the same time, another catbird's egg was accepted. A catbird's egg, however, on which small specks and blotches were painted was rejected. Nuttall (1840, p. 380) observed more than a century ago that other birds' eggs were "almost instantly ejected" from catbird nests.

Nickell's studies (1958, p. 286) of about 3,000 nests of the catbird in southern Michigan, over a period of 30 years, revealed that only eight nests were parasitized, or about 1 in every 375. "Six nests held one cowbird egg each at the time of discovery, and one held two eggs of the parasite. . . . All cowbird eggs had disappeared from five nests in less than a day from the time they were laid, one egg disappearing in less than an hour after being deposited."

A relatively few species of victims have been reported to bury cowbird eggs by building a new nest floor or wall over them. Among such species is the catbird; one occurrence, a nest with a cowbird egg covered over in the lining, was found at Cranbrook, Michigan (Detroit Audubon Soc., 1953, p. 74). More recently, the McGeens (1962, pp. 116–117) reported another instance, also in Michigan.

Occasionally, however, cowbird eggs are accepted and the parasitic chicks are reared by the catbird. Elder (1921, p. 185) reported that he had known a catbird to raise one or two of its own young along with a young cowbird. Recently, Nickell (1958, p. 286) reported a cowbird reared to the fledgling stage by a catbird in Michigan.

Some 26 actual instances of cowbird parasitism on this species have come to my attention, in addition to a number of indefinite statements or mere listings. These records come from Quebec, Maine, Massachusetts, New York, New Jersey, Pennsylvania, Maryland, Indiana, Michigan, Minnesota, Iowa, Kansas, Missouri, and North Dakota. Two subspecies of the parasite, the nominate race and the northwestern *M.a. artemisiae*, are involved, the latter race in the North Dakota records, the former in all the others. In the great majority of these cases, only 1 cowbird egg was found in the nest, but in Nelson County, North Dakota, on June 14, 1901, A. C. Bent collected a set containing 1 egg of the catbird and 4 of the cowbird, the latter apparently laid by two different individuals. Van Winkle (1890, p. 48) found a nest with 4 eggs of the catbird and 2 of the cowbird. A similar set, also in Michigan, was found by Berger (1951c, p. 117). This was the only parasitized nest out of 71 examined by him.

If the proposed races of the catbird, *rufricrissa* and *meridianus*, should be accepted by the next checklist, the present records would include both the nominate *carolinensis* and *meridianus*.

Brown Thrasher

Toxostoma rufum (Linnaeus)

Both subspecies of the brown thrasher, *rufum* and *longicauda*, are parasitized occasionally by the brown-headed cowbird (subspecies *ater* and *artemisiae*). This species is the largest passerine bird molested by the parasite—except for accidental victims—and it is the largest bird definitely known to have hatched and reared a young cowbird.

Thirty-one actual records of cowbird parasitism have come to my notice, reports that range from Quebec and Ontario to Saskatchewan in Canada, and from Connecticut, Pennsylvania, Maryland, Illinois, Michigan, and Iowa to Minnesota, Wisconsin, Kansas, North Dakota, Nebraska, Missouri, Tennessee, and Oklahoma in the United States. For many years J. A. Allen's observation of a female brown thrasher feeding a nearly full-grown fledgling cowbird in western Iowa in 1868, a report which was discussed by Baird, Brewer, and Ridgway (1874, p. 155), remained unique. In recent years, however, similar cases have been reported. Bent (1948, p. 371) noted an observation by T. Moore concerning a thrasher feeding three young fledged cowbirds, the details of which were published later by the observer himself (Moore, 1956, p. 558). More recently, Nickell (1955, pp. 90–91) has noted three nests of the brown thrasher containing chicks of the cowbird, indicating that the greater size of the host does not preclude the eventual success of the parasite. In two of the nests, young thrashers were developing together with the cowbird chicks; in the third, the cowbird chick also had nest-mates but it did not survive to the point of leaving the nest.

Long-billed Thrasher

Toxostoma longirostre (Lafresnaye)

All that is known of this species as a cowbird host is a report from the late R. D. Camp, who informed me that he had found the thrasher (subspecies *sennetti*) to be imposed upon by the dwarf race of the parasite near Brownsville, Texas.

Bendire's Thrasher

Toxostoma bendirei (Coues)

In the collections of the U.S. National Museum there is a set of 3 eggs of Bendire's thrasher with 1 of the dwarf brown-headed cowbird collected by E. A. Mearns near Red Rock, Arizona, April 3, 1885. This is the only instance of cowbird parasitism known to me.

Although a great number of the nests of this bird have since been examined, the above record has remained unique, a fact which suggests that Bendire's thrasher ordinarily is unmolested by the cowbird. Brown (1901) wrote that over a number of years he had examined

about 500 nests—but he made no mention of a cowbird egg in any of them. This apparent immunity to parasitism may be due partly to the early start of the thrasher's breeding season; eggs have been found as early as February 24, more than seven weeks before the first cowbird eggs are laid in the same region. However, since from late April until mid-July both birds are breeding, some as yet unknown factor may keep them apart.

Curve-billed Thrasher

Toxostoma curvirostre (Swainson)

The curve-billed thrasher is still known as a victim of the dwarf race of the brown-headed cowbird on the strength only of information given me (1929, p. 254) by the late R. D. Camp, who had found the bird parasitized near Brownsville, Texas, sometime prior to 1924. The local race of the thrasher is *oberholseri*.

Sage Thrasher

Oreoscoptes montanus (Townsend)

The sage thrasher has been recorded a single time as a victim of the western race of the brown-headed cowbird, *M.a. artemisiae*. In the summer of 1937, Twomey (1942, p. 456) found a parasitized nest in the Uinta Basin, Utah.

Robin

Turdus migratorius Linnaeus

This familiar bird is an uncommon victim. It is possible, however, that the brown-headed cowbird may lay in robins' nests more often than the records indicate; the robin's habit of throwing out strange eggs necessarily would do away with the evidence. All in all, I have learned of only 26 records, ranging from Quebec, Connecticut, New York, Maryland and the District of Columbia, to Ohio, Michigan, Wisconsin, Iowa, Missouri, North Dakota, Utah, and Alberta. Three races of the robin are involved: *propinquus* in the Uinta Basin, Utah (Twomey, 1942, p. 456) and Wahpeton, North Dakota (Jensen, 1918, p. 347); *achrusterus* in Maryland with four records (Stewart and Robbins, 1958, p. 329); and typical *migratorius* in the other listed areas. Two forms of the parasite are involved: *artemisiae* in North Dakota, Utah, and Alberta; and *ater* in all the other records. When one considers that hundreds of robins' nests are found each year, it is obvious that a total of merely 26 instances of cowbird parasitism over many years can mean only that the robin generally is unmolested by the cowbird. To mention a single example of the evidence: in the files of the British Columbia Nest Records Scheme there are data on 486 robins' nests, not one of which has been parasitized.

Many years ago I conducted some experiments to determine whether the robin distinguished foreign eggs from its own by differences in color or size or both, and it was found that color was the most decisive factor. Chipping sparrow eggs, which are even smaller than cowbird eggs, were accepted by the robins, in whose nests sparrow eggs were inserted along with their own, whereas larger eggs, more nearly the same size as robin eggs but dissimilar in color, were rejected. Nice (1941) made similar tests, using house sparrow eggs, and found that the majority were rejected (although some were accepted). Howell (1942, p. 560) independently tried similar experiments and found that alien eggs were removed but that an addled robin egg was accepted. Although cowbird eggs usually are not tolerated by robins, the latter will accept and rear very young nestlings of the parasite. On one occasion I put two very young cowbirds in a robin's nest which at the time contained only eggs. The robins took care of and reared the young cowbirds. An early case of a robin tolerating only the parasitic eggs was mentioned by Walton (1879, p. 78), who recorded an instance wherein the female robin was found sitting on a nest containing a cowbird's egg in addition to three of her own.

The robin's relative immunity from parasitism is due not solely to its ejection of the cowbird eggs; Leathers (1956, p. 68) observed an incubating robin vigorously attacking and driving from its nest an intruding female cowbird.

Wood Thrush

Hylocichla mustelina (Gmelin)

The wood thrush is a frequent victim of the brown-headed cowbird. Although it is not the commonest host in any one area, in some regions half or more of the nests of this bird are parasitized. The thrush is not as abundant as some of the hosts which outrank it in these areas, such as the song sparrow, the red-eyed vireo, or the yellow warbler. Over 75 records have come to my notice, ranging from Ontario, New York, Massachusetts, Rhode Island, Connecticut, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, and West Virginia to Ohio, Indiana, Michigan, Minnesota, Wisconsin, Iowa, Illinois, Missouri, Kansas, Tennessee, Arkansas, Oklahoma, and Texas. The typical eastern race of the cowbird is involved in all the records except one from the vicinity of Houston, Texas, where the breeding form of the parasite is the subspecies *obscurus*.

When I first compiled the data on this host (1929, pp. 257–258), I noted that Iowa seemed to be the region of greatest parasitism for the species; two-fifths of all the records came from that one state. I assumed that, as more records were published, this ratio would

change. Green, at Des Moines, Iowa, wrote (1887, p. 91) that one-half of the nests of this thrush which were found contained 1 or more cowbird eggs and that, in a single nest, he had discovered as many as 6 of the parasitic eggs with 2 of the thrush's. Similarly, Keyes and Williams (1888, p. 48) recorded the observation that this thrush frequently was parasitized, with from 1 to 4 cowbird eggs per nest. Stoner, also in Iowa (1919, pp. 80–81), recorded 12 parasitized nests of this bird. Since 1929, the total number of records of parasitism has increased by 50 percent, but so has the number of Iowa records. R. F. Johnston (in litt.) informed me that 6 out of 28 nests which he found in Kansas were parasitized.

In Minnesota, Hofslund (1950) noted 14 parasitized nests, one of which contained the surprising number of 9 cowbird eggs in addition to 2 of the thrush. He noted two different wood thrushes, each feeding three fledgling cowbirds.

A still more astonishing record is that of a nest found in the Rondeau Provincial Park, Ontario, in 1960, by Garry Hanes, and reported to me by R. D. Ussher; the nest contained 1 egg of the thrush and no less than 12 of the cowbird. Walter Nickell informed me that the area had been sprayed with DDT, a fact which may have reduced the number of nesting birds and may have forced the cowbirds to "concentrate" on fewer nests. In reply to my queries, Mr. Ussher wrote me that the eggs were of four distinct types: 3 were rather narrow and pointed with very heavy specklings; 2 were large eggs, coarsely speckled with heavily blotched wreaths at the large end; 4 were lightly and uniformly speckled; and 3 were rather coarsely but uniformly speckled. The appearance of the eggs suggested that four hen cowbirds may have been involved.

The late Lynds Jones informed me many years ago that he knew of a case wherein a wood thrush threw a cowbird's egg out of its nest, just as the robin does regularly. This remains only an exceptional instance because the thrush usually accepts the parasitic egg; in fact, Langille (1892, pp. 162–164) even found a wood thrush sitting in a nest containing a solitary cowbird egg.

Simmons (1915, p. 329) found a parasitized nest six miles west of Houston, Texas, April 9, 1911. This is the only recorded instance of the dwarf cowbird parasitizing the wood thrush.

Hermit Thrush

Hylocichla guttata (Pallas)

Four races of the hermit thrush (*guttata*, *auduboni*, *faxoni*, and *polionota*) have been reported as hosts of two races of the brown-headed cowbird (*ater* and *artemisiae*). As far as published information indicates, the species is rather uncommonly imposed upon, but it

should be noted that A. O. Gross (*in* Bent, 1949, p. 160) found the bird to be a fairly frequent victim. He writes that, although he had seen less than 15 nests of this thrush, four of them had been parasitized—two in Maine and two in Michigan. Furthermore, Cowan (1939, p. 44) at Tupper Lake, Peace River, British Columbia, reported that seven out of eight nests found were parasitized. These Tupper Lake records probably are better allocated to the nominate form of the host than to *faxoni* as I previously thought (1943, p. 354). In southern Quebec, over more than a half century of observation, Terrill (1961, p. 5) found 120 nests of the eastern hermit thrush, *faxoni;* of these, only six, or five percent, contained eggs or young of the cowbird. Other reports of parasitism on the eastern hermit thrush are on record from Alberta (Godfrey, 1952, p. 170), Montreal (Wintle, 1896, p. 90), Michigan (Swales, 1892, p. 45), and New York (Short, 1894, pp. 255–256; Burtch, 1910, p. 139). There is a single record for the subspecies *audubоni:* a set taken in Valley, Utah, June 12, 1912, comprising 3 eggs of the host and 1 of the parasite, now in the R. M. Barnes collection of the Chicago Natural History Museum. There must have been an earlier record, since Bendire listed *H.g. audubоni* as a cowbird host in his 1895 list. A parasitized set of eggs of the host race *polionota* was taken in Mono County, California, June 6, 1933; it is now in the collections of the Western Foundation of Vertebrate Zoology.

Swainson's Thrush

Hylocichla ustulata (Nuttall)

Swainson's thrush has been reported very seldom as a cowbird host; less than a dozen instances have come to my notice. The data involve two races of the host and three of the parasite. Smith (1926, p. 245) found a nest of the nominate race of the thrush near San Jose, California, containing 2 eggs of the host and 1 of the brown-headed cowbird (*obscurus*); another parasitized set, taken near Riverside, California, June 26, 1950, is now in the San Bernardino County Museum; these are the only instances for each of the foregoing subspecies. Horsbrugh (1918, p. 495) noted three cases of parasitism of the eastern race *H.u. swainsoni* at Sylvan Lake, Alberta; to this may be added a fourth case from Edmonton, a set now in the Rowan collection at the University of Edmonton. Stansell (1907, p. 120) recorded another from Alberta. All the Alberta records involve the northwestern race of the parasite, *M.a. artemisiae,* as do also two from Minnesota (Cass and Kittson Counties) listed by Roberts (1932, p. 129), one from Minnesota listed by Sparkes (1953), and one from Reeves Lake, Turnbull Refuge, Spokane County, Washington (from the files of the British Columbia Nest Records Scheme). The eastern form of the cowbird, *M.a. ater,* is involved in two instances of parasitism

on Swainson's thrush in Michigan, as reported by Swales (1893, pp. 100–101).

Veery

Hylocichla fuscescens (Stephens)

All three of the currently recognized races of the veery are parasitized by the brown-headed cowbird, two races of which, in turn, are involved in the various records. The veery is a fairly common victim, but the degree of frequency seems to vary considerably in different parts of its range. The records, approximately 80 in number, are from southern Quebec (subspecies *H.f. fuliginosa*); Ontario, Maine, Massachusetts, Connecticut, New York, Pennsylvania, Ohio, and Illinois (the foregoing, *H.f. fuscescens*); Michigan, Wisconsin, Minnesota, North Dakota, Manitoba, Saskatchewan, Alberta, and British Columbia (the foregoing, *H.f. salicicola*). The greatest frequency of cowbird parasitism has been reported from Charlevoix County, Michigan, where Nickell (1942, pp. 99–108) found that 16 out of 29 nests which were studied were parasitized. Since then he has added other local instances. At Ithaca, New York, in my own field work, 7 out of about 30 nests which were observed contained cowbird eggs or young. As many as 5 cowbird eggs have been found in one nest of this thrush. One such nest was found by B. W. Cartwright near Winnipeg, Manitoba, June 18, 1932, containing a single egg of the host together with 5 cowbird eggs, which appeared to have been laid by two different individuals. Another case, reported by Schorger (1931, p. 39) from Bayfield County, Wisconsin, contained 2 eggs of the thrush and 5 of the parasite.

In southern Quebec, Terrill (1961, p. 5) reported 17 parasitized nests out of a total of 128 nests examined. He found that the veery was a very tolerant host; he never saw any evidence that it attempted to eject or to bury the parasitic eggs.

Eastern Bluebird

Sialia sialis (Linnaeus)

The eastern, nominate race of the bluebird is known to be parasitized by all three races of the brown-headed cowbird. Nowhere is it a frequently used fosterer, but it is probably one of the most often victimized of all hole-nesting birds, the most affected in this regard being the prothonotary warbler. About 30 instances have come to my attention, ranging from Quebec, Massachusetts, Rhode Island, Connecticut, New York, Pennsylvania, and West Virginia westward to Ohio, Illinois, Michigan, Wisconsin, Iowa, Missouri, Arkansas, Oklahoma, Texas, and Wyoming. Simmons (1925, p. 172) lists the bluebird as a cowbird host in the area of Austin, Texas, where the breeding form of the parasite is the small race *obscurus*.

One Wyoming record (near Laramie) refers to the northwestern form of the cowbird, *artemisiae*, while all the other records refer to the nominate race of the parasite. In one case in Illinois, as many as 3 cowbird eggs were found in one nest with 6 eggs of the bluebird. From Wisconsin and Missouri there are records of nests with 2 cowbird eggs each in addition to the rightful eggs. In all the remaining cases there was but a single egg of the parasite.

In her detailed study (1946) of the bluebird in Arkansas, Thomas found one nest which was deserted because of cowbird parasitism. This is the only instance of desertion by this host which has been recorded definitely as such.

Western Bluebird

Sialia mexicana (Swainson)

The western bluebird, subspecies *bairdi*, is in the present catalog solely on the basis of its inclusion by Bendire in his list of victims of the dwarf race of the cowbird. It is obviously a very rare fosterer; Bendire gave no specific case, and none has come to attention elsewhere.

Mountain Bluebird

Sialia currucoides (Bechstein)

One record, a nest found by T. E. Randall, at Boyle, Alberta, May 29, 1934, containing 4 eggs of the bluebird and 1 of the brown-headed cowbird, subspecies *artemisiae*, first reported by me in an earlier paper (1938, p. 47), is still the only instance wherein this species is known to have been used by the parasite. The absence of additional records is not due to a lack of frequency with which nests of this bluebird have been found. In the files of the British Columbia Nest Records Scheme there are data on 115 nests of this bird, not one of which has been parasitized. In addition, Bent (1949, p. 288) mentions 107 "egg dates," none of which apparently involve eggs of the brown-headed cowbird.

Blue-gray Gnatcatcher

Polioptila caerulea (Linnaeus)

The blue-gray gnatcatcher is not an uncommon host, and in some areas it is even a fairly common victim. Two races, *caerulea* and *amoenissima*, are known to be victimized, the former by two races of the brown-headed cowbird, *ater* and *obscurus*, the latter by *artemisiae* and *obscurus*. Due to a change in the accepted nomenclature of the gnatcatchers, the name *P.c. obscura*, used in my 1929 book (p. 257) for the western form, is now restricted to the race of Baja California; the records formerly referred to this name now must be grouped under *P.c. amoenissima*. All in all, some 39 records have come to

my notice, distributed among the following areas: Ontario, Pennsylvania (eight records), New Jersey, Maryland, Virginia, North Carolina, Tennessee, Illinois, Michigan, Iowa, Alabama, Oklahoma, Texas, New Mexico, Colorado, California, and Michoacan, Mexico. Lowe (1917, p. 455) found that in Pueblo County, Colorado, the cowbird appeared to rely extensively on the gnatcatcher; there "the young may be seen yearly fed by gnatcatchers. It is rather strange that I have never known them (the cowbirds) to lay their eggs in the nest of any other species though they doubtless do so." In a similar fashion, Ligon (1961, p. 235) reported that, in New Mexico, this gnatcatcher was one of the frequent victims of the parasite; in California, Ashworth and Thompson (1930, pp. 122–124) also found these gnatcatchers rearing young cowbirds. In one case the hosts raised one of their own chicks together with one of the parasite's chicks. A noteworthy southern record is the one reported by Davis (1953, p. 95) from Tzitzo, Michoacan, Mexico.

Donald (1888, p. 26) reported a parasitized nest in Texas, and recently Nyc (in litt.) found another in the same state, containing no less than 3 eggs of the dwarf cowbird and 1 of the gnatcatcher. This is the largest number of parasitic eggs yet recorded for a single nest of this small host.

Occasionally, this species may cover over the strange eggs—if the latter are laid before any of the host's eggs are present. Spicer (1887, p. 38) at Goodrich, Michigan, found a pair of gnatcatchers building a nest; eleven days later he examined the nest and found that a cowbird had deposited an egg before "the owners, and that they had put in more lining and covered it entirely over, and had then built up the sides of the nest about three quarters of an inch higher. . . ."

Despite the lesser frequency with which the gnatcatcher is parasitized, as compared with some of the vireos, warblers, and sparrows, it has been noted as a cowbird host by such early writers as Wilson and Audubon and by numerous others since then, many of whom merely listed it as a known victim but gave no new instances.

Black-tailed Gnatcatcher

Polioptila melanura Lawrence

Three races of the black-tailed gnatcatcher are known to be imposed upon by the dwarf race of the brown-headed cowbird in Arizona, California, Baja California, Sonora, and Chihuahua. There are, in all, only 13 records with data in my files but, from discussion with observers of long experience, it is clear that these are only a fraction of the total number of such cases found and otherwise not placed on record; thus, it is not possible to appraise adequately this species

as a cowbird fosterer. No reason exists, however, for assuming the bird will be very different in this respect from the better known and more completely documented *P. caerulea*. This should be true despite the fact that Hanna (1934, p. 89) has suggested that the earlier breeding season of *P. melanura* (the extreme egg dates at Riverside being April 10 and May 30) may help it to escape excessive parasitism, especially early in the season. He also suggested that the usual habitat of this gnatcatcher, the dry bush-covered hillsides or dry gullies, might have an isolating effect so far as cowbirds are concerned, but this is not at all certain.

Baird, Brewer, and Ridgway (1874, p. 157) noted that at Cape St. Lucas, Baja California, Xantus found cowbird eggs in nests of the black-tailed gnatcatcher, the local race of which is *P.m. margaritae*. This is all that has been recorded for the race.

The Arizona-northwestern Mexican form, *P.m. lucida*, is known as a cowbird host from the following records. G. Bancroft informed me that he collected two parasitized sets of eggs, one at Santa Eulalia, Chihuahua, and one at Guaymas, Sonora. A. R. Phillips (in litt.) noted a recently fledged cowbird being attended and fed by a male black-tailed gnatcatcher near Granados, northeastern Sonora, on August 10. Swarth (1905, p. 79) found a fledgling cowbird being attended and fed by a black-tailed gnatcatcher in the Santa Rita Mountains, Arizona. At Sacaton, Arizona, Gilman (1915, p. 88) found a parasitized nest, and at Alamo Ranch, near Tucson, Brandt (1951, pp. 80, 133, 684) reported two more parasitized nests. Monson (1949, p. 248) found a fledgling cowbird being attended by one of these gnatcatchers, at Tucson, Arizona. Brewster (1882, p. 77) reported a parasitized nest which was found at Yuma, Arizona, by Stephens. W. J. Sheffler informed me that in Arizona he found many parasitized nests of this host; in fact, at times he was led to wonder how the gnatcatchers were able to withstand the pressure of cowbird parasitism and to raise enough of their own young to maintain their population.

Bent (1949, p. 371) quoted Rowley, who observed that "along the Colorado River area, cowbirds parasitize the nests of these birds rather abundantly . . . " and who noted that he had "found a female setting on three eggs of a cowbird and none of her own, with many nests containing one or two cowbird eggs."

For the California race, *P.m. californica*, there are four records: Woods (1930, p. 126) saw a pair of these birds feeding an almost fully grown cowbird at Azusa in June 1928; Clyde L. Field found a parasitized nest at National City, April 24, 1929; N. K. Carpenter found another in San Diego County; Hanna (1934, p. 89) found still another at Riverside in May 1933.

Ruby-crowned Kinglet

Regulus calendula (Linnaeus)

The ruby-crowned kinglet is rarely victimized; only six records, five for the nominate race of the kinglet and one for the race *R. c. cineraceus*, are known to me. Davie (1889, p. 428) reported a nest with 9 eggs of the owner and 1 of the cowbird taken at Lennoxville, Quebec, May 15, 1882, by Montague Chamberlain; Terrill, also in southern Quebec, found two nests with cowbird eggs in them; Holt (1942, p. 589) found a ruby-crowned kinglet feeding a very recently fledged cowbird at Scarboro Beach, Maine, July 22, 1941; A. D. Henderson informed me that he once found a parasitized nest near Belvedere, Alberta. In the collections of the Western Foundation of Vertebrate Zoology there is a set of 7 eggs of the western race of this kinglet with 1 of the brown-headed cowbird, collected in Mono County, California, June 23, 1948. This and the Alberta record involve the northwestern race of the parasite, *M.a. artemisiae;* the others are all of the nominate subspecies.

Sprague's Pipit

Anthus spragueii (Audubon)

Sprague's pipit has been recorded as a victim of the northwestern race of the brown-headed cowbird a single time. A nest containing 3 eggs of the pipit and 2 of the parasite was found by Albert C. Lloyd at Last Mountain Lake, southern Saskatchewan, May 29, 1932, and was reported by Todd (1947, p. 417).

Bohemian Waxwing

Bombycilla garrula Linnaeus

The Bohemian waxwing breeds largely in regions where the brown-headed cowbird does not breed, but in at least one area of sympatry on one occasion it has been recorded as a host of the parasite. The record, kindly sent me from the files of the British Columbia Nest Records Scheme, reports that a deserted nest, containing 3 eggs of the host and 2 of the cowbird, was found on June 27, 1957, at Grand Forks, British Columbia. The host is the North American race *B.g. pallidiceps,* and the parasite, *M.a. artemisiae.*

Cedar Waxwing

Bombycilla cedrorum Vieillot

The cedar waxwing seldom is parasitized, but it has been recorded as a host in Ontario, Quebec, New York, Connecticut, Ohio, Michigan, Wisconsin, Minnesota, Montana, Alberta, and British Columbia. I have learned of only 18 actual cases. Those from Montana, Alberta, and British Columbia refer to the northwestern race of the cowbird,

M.a. artemisiae; the others, to the typical subspecies *M.a. ater*. The fact that the waxwing is a late breeding bird and that usually it does not begin to nest until the laying season of the cowbird is well past its height probably explains its relative immunity from the attentions of the parasite. Over a period of 50 years in southern Quebec, Terrill (1961, p. 5) found 329 waxwing nests, of which only 4 had been parasitized by the cowbird.

One new item of information about this uncommon victim of the brown-headed cowbird has been brought to light recently by Nickell (1955, pp. 91–92). He points out that the waxwing, unlike many birds, begins to incubate after the laying of the first egg and that, as a result, the eggs may hatch at intervals rather than all together. Nickell found a nest with 2 young waxwings about four or five days old and 2 young cowbirds—one about six days old, the other three days old—plus 1 waxwing egg. He attributes the early hatching of the older cowbird to this peculiar mode of incubation.

This fact leads to the following consideration. In the majority of cases, cowbird eggs are laid in nests already containing eggs of the hosts and, in many cases, the cowbird eggs develop slightly more rapidly than do their nest-mates, giving them the advantage of earlier hatching. It would appear, therefore, that, in a species with the incubation habits of the waxwing, such a pattern might offset the parasite's advantage—or at least make it more likely that one or more of the host's young would survive with it and compete with it.

Phainopepla

Phainopepla nitens (Swainson)

This bird has been reported only twice as a victim of the dwarf race of the brown-headed cowbird. Strong (1919, p. 181) reported a phainopepla's nest containing 1 egg of the parasite which was found by Frederick Dunham at Tucson, Arizona, on May 20, 1897. Rowley (1930, pp. 130–131) recorded a nest containing a young cowbird as well as a young phainopepla on June 2, 1929, near Alhambra, southern California. "The cowbird actually was forcing the young 'Pep' from his rightful cradle, and the adults were simply gorging the hoggish young cowbird with all the food it could hold, seemingly forgetting about their own 'child' that was . . . in the bottom of the overcrowded nest." Both records refer to the subspecies *lepida* of the host.

Starling

Sturnus vulgaris Linnaeus

The hole-nesting habits and the pugnacious disposition of the starling probably are the reasons for its being molested very seldom by cowbirds. Only two records of parasitism on this introduced

species, out of many hundreds of nests examined by various observers, have come to my notice. Mr. E. J. Court informed me that A. H. Hardisty once found a cowbird's egg in a nest with eggs of the starling near Beltsville, Maryland. Blocher (1933, p. 157) reported a parasitized nest at Amboy, Illinois.

Black-capped Vireo

Vireo atricapilla Woodhouse

The black-capped vireo is an infrequently reported and probably a fairly uncommon victim. Twelve instances of cowbird parasitism on this vireo have come to my notice, involving two races of the parasite, *ater* and *obscurus*. Four records from Oklahoma, three of which were mentioned by Nice (1931, p. 150) and observed by G. W. Morse at Tulsa, concern the nominate subspecies of the cowbird, while seven from Texas (Comal and Travis Counties) involve the dwarf race. One of the latter records, from Austin, includes the observation of a fledgling cowbird reared by a black-capped vireo; the others are all egg records.

White-eyed Vireo

Vireo griseus (Boddaert)

The white-eyed vireo is a fairly frequent host, first recorded in this capacity by Alexander Wilson (1810, p. 166) in the early days of American ornithology. The general scarcity of published data on this bird is reflected in the fact that, in my first summation (1929, p. 237), I was aware of about 20 records; in the 30 years or so since then, I have been able to add only 37 more. The records range from Connecticut, New York, New Jersey, Pennsylvania, and Virginia to Illinois, Tennessee, Georgia, Alabama, Louisiana, Texas, Oklahoma, Kansas, and Tamaulipas, Mexico. Many years ago Mr. S. J. Darcus informed me that he had found two parasitized nests of this vireo at Fredericton, New Brunswick, in 1909 and 1910. This information I published (1934, p. 34) because of its far northeastern locality, but at present I prefer to consider the record somewhat doubtful for the very reason of its location. Bent (1950, p. 235), nevertheless, states that the breeding range of the white-eyed vireo extends to "Gaspé County, Quebec (L'Anse Pleureuse); New Brunswick (Fredericton and St. John, probably) . . . ."

Although few actual cases have been put on record since Singley's original instance (1888) in southern Texas, Mr. R. W. Quillin and the late R. D. Camp found the local race of this vireo, *V.g. micrus*, to be very commonly parasitized. The southernmost instance involves a nest with 4 eggs of the vireo and 1 of the dwarf race of the cowbird found at Reynosa, Tamaulipas, Mexico, May 4, 1941, and

now in the Cruttenden collection, Quincy, Illinois. The records from Oklahoma northward all refer to the host subspecies *V.g. noveboracensis* and all involve the nominate race of the parasite.

Since most of the records are based on eggs found in nests, the fact should be pointed out that the white-eyed vireo has been known to rear young cowbirds. Such was observed by Stone (1937, p. 877) on three occasions at Cape May, New Jersey. In one of these instances the pair of vireos was feeding two young cowbirds.

Hutton's Vireo

Vireo huttoni Cassin

Hutton's vireo seldom is reported as a victim. Eight records have come to my attention, six from California, involving the nominate race of the host, and one each from Texas and New Mexico, involving the race *stephensi* From California, Hanna (1928, p. 161) listed one nest containing 2 cowbird eggs in the San Bernardino Valley and another (1938) in Riverside County; M. C. Badger informed me that he had found a parasitized nest at Santa Paula, and H. W. Carriger wrote to me that he had found two more cases near Oakland (in one of the latter the nest contained a large young cowbird, almost ready to leave); Grinnell and Wythe (1927, p. 104) recorded Hutton's vireo as a cowbird victim in California on the basis of a parasite nestling taken from a nest between Niles and Irvington, June 15, 1923, by H. V. LaJeunesse. From New Mexico, Mitchell (1898, p. 309) noted *stephensi* as a cowbird victim in San Miguel County; in my first account (1929, p. 189) I rejected this record on the basis of the locality, which is considerably north of the known range of the vireo, but later I noticed that Ridgway and others had accepted it; the A.O.U. Check-list, however, still includes only southern New Mexico in its range. From Texas, Fred F. Nyc, Jr., wrote me that on May 22, 1951, nine miles west of Hot Springs, Brewster County, he found a nest of *stephensi* containing 4 eggs of its own and 1 of the dwarf race of the cowbird. The California records also refer to the small race of the parasite, but the New Mexico report involves the nominate race, *M.a. ater.*

Dwarf Vireo

Vireo nanus Nelson

Previously unknown as a cowbird host, this vireo now may be added to the list of victims of the dwarf race of the parasite. In the Moore Collection, Occidental College, there is a set of 4 eggs of the vireo and 2 of the cowbird, taken on June 17, 1943, five miles northeast of Irapucto, Guanajuato, Mexico.

Bell's Vireo

Vireo bellii Audubon

Bell's vireo is a frequent victim of the cowbird in an area that extends from Illinois, Wisconsin, Iowa, Nebraska, Kansas, Oklahoma, and Texas to Arizona and southern California. All four races of this bird recognized within the United States are known to be affected—typical *bellii* from Illinois to north-central Texas, *medius* in Brewster County, Texas, *arizonae* in southern Arizona, and *pusillus* in southern California. The first of these is parasitized by the eastern form of the cowbird, *M.a. ater*; the other three, by the dwarf race, *M.a. obscurus*. In the course of many years I have learned of 82 actual cases of cowbird parasitism, but these constitute only a fraction of the number that lie back of the numerous estimates put forward by various authors. Attwater (1892, p. 237) considered it a rare occurrence to find an unparasitized nest in Bexar County, Texas. Bendire (1895, p. 442) found it "almost impossible to obtain a full set of eggs of the Least Vireo, nearly every nest containing one or two eggs of this parasite, and usually only one or two of its own, and the latter were frequently punctured." R. W. Quillin wrote me that, in San Antonio, Bell's vireo is a very frequent victim; he added that it sometimes covers over the parasitic eggs with a new lining to the nest and that it occasionally may "push the foreign eggs from the nest, as I have seen many, many eggs of the Cowbird on the ground under a nest of this species. Yet the Bell's Vireo will hatch the eggs in the majority of cases." Other observers have had different experiences with this bird. Lantz (1883, p. 95) concluded that parasitized nests were usually deserted. Moore (1928) came to a similar conclusion, suggesting, as a result of his observations, that the vireo leaves its old nest when molested by the cowbird and builds a new one near the original site. He found 10 such nests within about a hundred yards and only one pair of vireos in the vicinity. Since only two of the nests showed evidence of parasitism, the explanation he offered, however, does not fit the case too well. Pitelka and Koestner (1942) described an instance wherein the evidence indicated that cowbird parasitism was the probable cause of desertion of the first two, and possibly three, nests of a pair of these vireos. At each of the nests the desertion took place after the removal of an egg of the host. Dawson's statement (1921, p. 31) that "one irate vireo I saw who seized a cowbird three times her size and dragged her off the nest by main force" may be discounted as highly inaccurate. The most that a vireo could do would be to hover about excitedly and possibly peck at a visiting cowbird which was on its nest.

Barlow's recent work (1962, pp. 291–292) in Kansas has revealed that the incidence of cowbird parasitism is greater in the case of

Bell's vireo than in that of any other local host. Out of 35 occupied nests of this bird, 24, or 68.6 percent, were parasitized, whereas, out of 43 nests of other parasitized passerine species, 14, or 32.6 percent, were so affected. Barlow found that, with this species as host, the percentage of cowbird eggs which hatched as compared to the number that were laid was relatively low. He considers that Bell's vireo is less tolerant of cowbird parasitism than are many of the other frequently chosen victims.

The study by Nice (1929, pp. 13–20) suggests that the nest mortality of this vireo is often very high and, since the cowbird is often a factor in the mortality, the parasite's importance in the population dynamics of the host is heightened thereby—although difficult to estimate. Of 17 nests studied by Nice, the outcome of two was unknown, but the other 15 came to untimely ends. In three cases the cowbirds seemed to have caused desertion, in three others there were cowbird eggs, but only in one case was a young cowbird raised successfully. Nice pointed out that Bennett (1917) reported on 13 nests, of which nine were failures, three were successes, and one remained incomplete for study purposes. Of the nine failures, seven ostensibly were due to cowbirds.

Savary (1936, p. 64) reported one parasitized nest of a Bell's vireo containing 4 cowbird eggs and none of the vireo. He considered the eggs to be so similar that they were almost certainly the product of one cowbird.

Gray Vireo

Vireo vicinior Coues

This is a frequently imposed upon victim, for which I have noted dwarf race of the brown-headed cowbird: at Cajon Pass, northwest of San Bernardino, California, on June 4, 1944, Hanna (1944, p. 244) found a nest containing 2 eggs of the vireo and 1 of the parasite. In the collection of the San Bernardino County Museum, however, there are two additional records—one from near Hesperia, San Bernardino County, and the other from Sheep Creek Canyon, San Gabriel Mountains.

Yellow-throated Vireo

Vireo flavifrons Vieillot

This is a frequently imposed upon victim, for which I have noted about 100 records. They are distributed among the following areas: Ontario, Quebec, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Maryland, and Ohio to Indiana, Michigan, Minnesota, Iowa, Illinois, Kentucky, Tennessee, Alabama, Arkansas, Oklahoma, and Kansas. In some places this vireo is reported as a common host while in others, even where both it and the

cowbird are numerous, it is relatively unmolested by the parasite. Occasionally this host may bury the cowbird's egg under a new nest lining if it has no eggs of its own at the time; such a case was reported by Jacobs (1903, p. 19). The yellow-throated vireo has been known to rear cowbirds successfully to the fledging stage. All the records of parasitism on this bird involve the typical race of the cowbird.

Solitary Vireo

Vireo solitarius (Wilson)

The solitary vireo is parasitized less commonly than the white-eyed and the yellow-throated and much less so than either Bell's or the red-eyed vireos. I know of 20 records, involving four races of this bird: *solitarius* (in Massachusetts, New York, Michigan, and Minnesota), *alticola* (in West Virginia), *plumbeus* (in Alberta, Montana, New Mexico, and Arizona), and *cassinii* (in Oregon and California). All three races of the parasite are involved: *ater* is the form parasitic on *solitarius*, *plumbeus*, and *alticola; artemisiae* and *obscurus* both victimize *plumbeus* and *cassinii*. Although a majority of the reported instances are egg records, the fact is known that the solitary vireo successfully may rear young cowbirds. A. H. Miller (1948, p. 92) saw solitary vireos with young cowbirds in the open pine woods of Powder River County, Montana, in June, 1947; similar observations also have been reported from Minnesota by Roberts (1932, p. 176). However, judging by not very abundant data, it seems that the solitary vireo is somewhat more prone to cover over cowbird eggs with new nest lining than to allow the young to hatch; this habit the vireo reveals more than the other species of its family. Allen (1913, pp. 296–300) and Greene (1892, pp. 8–9) have published accounts of such behavior.

Since the records for the races *alticola*, *plumbeus*, and *cassinii* are still few in number, they can be itemized here. *V.s. alticola* so far is known from two instances. Dickey (1941, pp. 111, 112) found a nest with 3 eggs of the vireo and 1 of the cowbird near Cheat River, West Virginia, and another nest with a cowbird egg embedded in its wall at Point Mountain, Randolph County, West Virginia. The western subspecies, *V.s. plumbeus*, is known as a victim in the following localities: Power River County, Montana (Miller, 1948, p. 92); Grassland, Alberta, where a parasitized set of eggs was collected June 8, 1935, a set now in the William Rowan collection at the University of Alberta; Boyle, Alberta, where a set of eggs was collected May 28, 1934, by T. E. Randall; New Mexico, according to Bailey (1928, p. 661) on information received from Stokley Ligon; and Arizona, where Alex Walker found a nest with 3 eggs of the vireo and 1 of the dwarf race of the cowbird on June 15, 1932, in Montezuma Canyon in the

Huachuca Mountains at 5400 feet elevation. Finally, the subspecies *V.s. cassinii* was found to be parasitized at Yosemite, California, by Michael (1935, p. 178) and near Milton, San Joaquin County, California, by W. B. Sampson. The latter informed me that on May 30, 1932, he found a nest containing 2 eggs of the cowbird together with 2 of the vireo. Kebbe (1954, p. 51) found another parasitized nest on May 6, 1954, at McKay Creek near North Plains, Washington County, Oregon. Bent (1958, p. 453) noted that J. Stuart Rowley had found a parasitized nest at Lake Arrowhead, San Bernardino County, California. Two similar sets, collected in the same county, are now in the San Bernardino County Museum. In the collection of the California Academy of Sciences there is a cowbird egg taken from a Cassin vireo nest in Alameda County, May 13, 1934, by H. W. Carriger.

Yellow-green Vireo

Vireo flavoviridis (Cassin)

This vireo is a very poorly known victim; only a single observation has been reported. Lawrence (1874, p. 280), quoting Grayson, wrote that, near Mazatlan, Sinaloa, Mexico, the yellow-green vireo is "the preferred host" of the dwarf race of the brown-headed cowbird. Lawrence's statement is the basis, in turn, for that of Salvin and Godman (1886, p. 451).

Red-eyed Vireo

Vireo olivaceus (Linnaeus)

The red-eyed vireo is one of the commonest hosts used by the brown-headed cowbird. No species is molested more—either in the total number of cases or in the percentage of nests that are parasitized. The cases are so numerous that it is possible only to estimate them; a total in excess of 875 was noted finally, at which point there seemed no reason to accumulate any more. The records range from Alberta, British Columbia, New Brunswick, Ontario, Quebec, and Saskatchewan, in Canada, to the following states in the United States: Alabama, Arkansas, Colorado, Connecticut, Delaware, District of Columbia, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Maryland, Massachusetts, Michigan, Minnesota, Montana, New Jersey, New York, North Dakota, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Dakota, Tennessee, Texas, Virginia, Washington, West Virginia, Wisconsin, and Wyoming. All three races of the parasite are involved: *obscurus* in the San Antonio area of Texas, *artemisiae* in the region from British Colombia east to Saskatchewan and south to Colorado and Wyoming, and *ater* in the remaining localities.

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In recent years, data of higher quality, especially in their significantly quantitative aspects, have been put on record by observers such as Southern, who made an extensive study (1958) of this vireo in the Douglas Lake region of Michigan. Out of 104 nests which he found, no fewer than 75, or 72.17 percent, were parasitized. Of the 69 nests which contained cowbird eggs when the nests first were found, 32, or 46.38 percent, contained more than a single cowbird egg apiece. In several nests, the cowbird eggs were similar enough in size and coloration to suggest that they were laid by one female, but in cases where there were as many as 3 parasitic eggs, two cowbirds were involved.

Southern found that the incidence of survival of the nestling vireos in parasitized nests was greater than earlier observational data had indicated. There were 24 parasitized nests which produced fledglings and, in these, the success of the cowbird was 87.08 percent. "Of the nests fledging no vireo young, two produced three cowbirds; and four produced two cowbirds. On the other hand, six fledged one vireo and two cowbirds; nine nests fledged one cowbird and no vireos; and three nests fledged one of each species. These figures indicate that the cowbird is highly successful after hatching occurs; the young usually survive whereas those of the host do not." Still, nine nests did produce fledglings of both species—which is more than might have been expected. Southern states that "the cowbirds were probably to blame for the loss of many vireo eggs and young as well as causing the actual desertion of vireo nests by laying too many eggs in them. Of the 19 vireo nests deserted, 17 contained cowbird eggs; four contained eggs of the host and cowbird in equal numbers; 11 contained from one to seven eggs of the parasite only; and two nests contained fewer eggs of the cowbird than of the vireo. These figures substantiate my contention that an excessive number of cowbird eggs caused the desertion of many vireo nests." The nesting success of the vireo, based on the number of eggs laid in the 32 nests producing vireo young, was 87.49 percent; the nesting success of the vireo, with reference to the 48 nests that fledged young vireos and/or young cowbirds, was 66.66 percent. The total nesting success of the vireo in 78 nests, observed through fledging, destruction, or desertion, was 41.03 percent.

We should compare these figures with those published by Lawrence (1953) from a study in central Ontario, a forested area where, because the cowbird is locally absent, the vireo is unmolested. He found that the nesting success of 35 nests was 63 percent and that the hatching success of eggs in 30 nests was 60 percent.

In his summary of cowbird parasitism in Ohio, Hicks (1934) noted that, out of 231 observed nests of the red-eyed vireo, 84, or 36 percent,

were parasitized. In southern Quebec, Terrill found that 26 out of 63 nests, or 41 percent, were so affected.

In its surveys of the nesting birds of the Detroit region, the Detroit Audubon Society (1953, p. 72; 1954, p. 85; 1956, p. 90) reports that the red-eyed vireo is one of the most heavily parasitized birds in that area. This conclusion, however, is a comment more upon the vireo as a cowbird host than upon the cowbird as a vireo parasite. The yellow warbler and the song sparrow were the most frequent hosts in the locale; far more of their nests were found with cowbird eggs or young than was the case with the red-eyed vireo. Only in the percentage of parasitism of the total number of observed nests did the vireo emerge as a more frequently victimized species.

In southern Quebec, Terrill (1961, p. 6) examined 64 nests, of which 27, or 42.2 percent, were parasitized. He concluded that the red-eyed vireo was victimized more regularly in that area than any other host species.

To return to Southern's study, we should note his concluding observation that, although both the vireo and the cowbird were common birds in the study area, if "the vireo population were in any way being 'harmed' by the cowbird, it was not apparent. Possibly parasitism by the cowbird was a natural device for preventing an over-production of vireos. When considering the number of species parasitized by the cowbirds in my study area it does seem possible that, if the cowbird enjoyed equal success with other hosts, it might become too numerous. But I strongly suspect that the cowbird has few other hosts in the region that it parasitizes with any comparable success."

Occasionally, the red-eyed vireo covers over or buries the parasitic eggs in the manner of the yellow warbler and some other birds, but it has been known to accept and to incubate cowbird eggs even when none of its own were present. Uusally it is an extremely tolerant host. Although in the majority of cases only 1 parasitic egg was present, there are numerous instances of 2, and fewer instances of 3 and even 4, cowbird eggs in a single nest. An extreme case of multiple parasitism, mentioned by Bent (1958, p. 438), was a nest containing 6 cowbird eggs and none of the vireo, a phenomenon reported by F. A. E. Starr, who found the vireo, nevertheless, sitting on this unusual clutch.

Philadelphia Vireo

Vireo philadelphicus (Cassin)

The Philadelphia vireo is a rarely reported victim: only two records have turned up. T. E. Randall wrote me that he found a nest of this vireo with an egg of the cowbird (subspecies *artemisiae*) in Alberta. Baillie and Harrington (1937, p. 239) recorded that in the Sudbury district, Ontario, on July 18, 1937, C. E. Hope saw a Philadelphia

vireo attending and feeding a recently fledged cowbird (subspecies *ater*).

Warbling Vireo

Vireo gilvus (Vieillot)

The warbling vireo is a frequent host of the brown-headed cowbird; 64 records have come to my attention, involving three races of the vireo, *gilvus*, *swainsonii*, and *leucopolius*, plus all three subspecies of the parasite. The records range from British Columbia, Alberta, and Washington eastward to Minnesota, Wisconsin, Illinois, Indiana, Ohio, Ontario, Quebec, Connecticut, New York, New Jersey, and Pennsylvania and southward to California, Oklahoma, Iowa, and Tennessee. In my own field work at Ithaca, New York, I observed only two cases, but in other localities this vireo seems to be imposed upon to a greater extent. Eaton (1914, p. 227) lists the warbling vireo as one of the most frequent victims in New York State. A similar estimate was made in southwestern Pennsylvania.

Since there are still relatively few records for the two western races of both the vireo and the cowbird, these can be listed here. The subspecies *V.g. swainsonii* has been recorded as a host of *M.a. obscurus* in California by Sherwood (1929, p. 3) and by H. W. Carriger near Oakland, June 2, 1929; a third record is a parasitized set of eggs from San Diego County (G. Bancroft Collection); a fourth, from the San Gabriel Mountains and now in the San Bernardino County Museum; and a fifth, from the same area and now in the collections of the Western Foundation of Vertebrate Zoology. Coues (1878, p. 513) stated in an indefinite way that the host race *V.g. swainsonii* was victimized, but he gave no actual instances. Nice (1931, p. 171) recorded this race as a victim of *M.a. ater* in Oklahoma, with a record from Kenton, Cimarron County. Mr. T. E. Randall informed me that he had found *swainsonii* to be parasitized by *M.a. artemisiae* in Alberta, and E. M. Tait found three victimized nests at Trout Creek Point, British Columbia.

For the subspecies *V.g. leucopolius*, there are the following two records, both involving *M.a. artemieiae*. Jewett, Taylor, Shaw, and Aldrich (1953, p. 551) mentioned that, at Spokane, Washington, May 30, 1924, Sloanaker found a nest containing 3 eggs of the vireo and 1 of the cowbird. Schultz (1958, p. 435) recorded an instance of a pair of these vireos feeding a recently fledged cowbird near Seattle, Washington.

Slaty Vireo

Neochloe brevipennis (Sclater)

A single instance of the slaty vireo as a host of the small southwestern race of the brown-headed cowbird has been recorded by

Rowley and Orr (1960). On June 13, 1958, in a pine-oak forest three miles east of Cuernavaca, Morelos, Mexico, Rowley found a nest containing 3 eggs of the vireo (nominate race) and 1 of the parasite; the eggs are now in the collection of the California Academy of Sciences.

Black-and-white Warbler

Mniotilta varia (Linnaeus)

The black-and-white warbler is a somewhat uncommon victim of the brown-headed cowbird; only 38 instances have come to my notice. The cases range from Alberta eastward to Ontario and Quebec, and southward to Massachusetts, Rhode Island, Connecticut, New York, Pennsylvania, Ohio, Illinois, Michigan, Missouri, Iowa, Kansas, and South Carolina (with one instance). There is also only one record from Alberta—a parasitized nest found there by T. E. Randall and involving the northwestern race of the parasite, *M.a. artemisiae*. All the other records refer to the eastern race *M.a. ater*. Although in most places this warbler is imposed upon rather infrequently by the parasite, it should be noted that Kells (1902, p. 230) considered it to be seriously molested at Listowell in south-central Ontario. In southern Quebec, Terrill (1961, p. 6) reported four cases of parasitism out of 14 nests that were observed. Although most of the recorded instances involve cowbird eggs in nests of this bird, Morden's observations (1884, pp. 193–194) show that the black-and-white warbler may, and does, rear the young parasites. He found two well-nourished young cowbirds in a nest and underneath them there were an addled cowbird egg and two young warblers nearly dead from starvation or suffocation. As many as 5 cowbird eggs, together with 3 eggs of the warbler, have been reported from a single nest (Trippe, 1868, p. 171–172); Byers (1950) found 8 cowbird eggs in a nest, with 2 eggs of the warbler, near Half Moon Lake, Michigan. The South Carolina record, a set of 3 eggs of the warbler and 1 of the cowbird, taken in Anderson County, May 1, 1893, by C. B. Crayton and now in the Bent collection in the United States National Museum, is of interest as a far southeastern record.

Prothonotary Warbler

Protonotaria citrea (Boddaert)

Because of its habit of nesting in holes—frequently in dead trees in swampy places and even in standing water—to find this species often parasitized by the cowbird is somewhat surprising. No less than 54 definite records have come to my notice from Ontario in Canada and from Alabama, Arkansas, Delaware, Illinois, Indiana, Iowa, Minnesota, Missouri, New Jersey, Ohio, Oklahoma, and Virginia in the United States. All of these cases involve the eastern, nominate

subspecies of the cowbird. The degree to which the warbler is imposed upon in certain areas is demonstrated by the fact that, in the J. P. Norris collection alone, 18 out of 70 sets of prothonotary eggs contain 1 or more eggs of the cowbird and that all of these 18 victimized sets were collected within two weeks at Burlington, Iowa, where a total of some 35 sets of eggs were taken. In other words, the incidence of parasitism at Burlington during that period was a little over 50 percent.

In his detailed study of the prothonotary warbler, Loucks (1894, pp. 31–32) wrote that to find 1 or more eggs of the cowbird in nests of this bird was not unusual. As many as 4 eggs of the parasite, together with 4 of the host, have been reported from a single nest; Bent (1953, p. 27) mentions a nest containing 7 cowbird and no warbler eggs. Several instances of double-storied nests of this bird, with a cowbird egg buried in the lower part, are on record; however, the warbler usually accepts and incubates the strange eggs. I am not aware of a definite record of this bird actually rearing one of the parasitic young, but we can assume that it not only can but does do so.

Swainson's Warbler

Limnothlypis swainsonii (Audubon)

Swainson's warbler is known to be parasitized by the cowbird in Copan County, Oklahoma. A. J. Kirn (1918, pp. 97–98) reported that, "during the season of 1917, six different nests were found in a strip of woods a mile long and a little over a quarter of a mile in width, built by at least four different pairs of birds; two held eggs, one with Cowbird's, two were deserted, one held a punctured egg of the owner, the other a Cowbird's and a punctured Warbler's egg and a broken Warbler's egg on the ground beneath. Three or four eggs are laid or if Cowbirds are present, and they usually are, sometimes three eggs are laid." This statement, quoted by me in an earlier publication (1929, p. 239), is still the only pertinent observation on record. The fact that in more than 40 years since the record was made no one has added to it, although not a few nests of the warbler have been found, suggests that, at best Swainson's warbler is a very local host. Since most of its breeding range lies outside that of the parasite, we are safe in concluding that neither bird plays an important role in the economy of the other.

Worm-eating Warbler

Helmitheros vermivorus (Gmelin)

This is an uncommonly reported host. When I first (1929, p. 239) compiled the available data on the worm-eating warbler as a cowbird host, I knew of 21 definite records. In more than 30 years since then I have been able to add only 16 more. In some places, however, such

as Green County, Pennsylvania, the incidence of cowbird parasitism is very high, as shown by Jacobs (1924, pp. 52–54) and S. S. Dickey (1934, pp. 179–184), who together found no fewer than 17 parasitized nests. In the experience of the latter observer, 8 out of 23 nests found near Waynesburg had been molested. In no other area has this warbler been reported to this extent as a cowbird host. Near West Chester, Pennsylvania, Ladd (1887b, pp. 149–151) found 24 nests, 3 of which contained eggs of the cowbird. The total available records range from Connecticut, New York, New Jersey, Maryland, and Pennsylvania to Indiana, West Virginia, Kentucky, and Iowa.

This warbler has been found to hatch and rear young cowbirds. Ladd (1887a, p. 110) noted a nest containing one young cowbird, nearly fully fledged, plus an addled cowbird egg and 5 eggs of the host. Dickey (loc. cit.) near Blacksville, West Virginia, observed a nest with three young warblers and two young cowbirds.

All the records for this host involve the eastern, nominate race of the parasite. The latter may be said to be important only locally in the demography of this warbler; even here it is not apparent that this host plays a great role in the economy of the cowbird.

Golden-winged Warbler

Vermivora chrysoptera (Linnaeus)

The golden-winged warbler is an occasional victim of the brown-headed cowbird. I have been able to learn of 17 definite records in addition to mere statements in the literature that this warbler is a cowbird host. The records come from Massachusetts, New York, New Jersey, Pennsylvania, Michigan, and Wisconsin. In Greene County, Pennsylvania, Jacobs (1904, pp. 19–21) found 20 nests, of which 6 were parasitized. This, together with the fact that at least four more parasitized nests recently have been reported from Michigan (Wallace, 1945, p. 174; Detroit Audubon Soc., 1953, p. 72; 1954, p. 86; 1956, p. 86), qualifies our concept and points to the conclusion that, where it occurs in any numbers, this warbler is a regular victim. As many as 4 cowbird eggs have been found in a single nest. Not only have eggs of the cowbird been found in nests of this species, but also young of the parasite have been reared by golden-winged warblers in at least three cases—in two of which the young of the host survived together with the young parasite. In one of these cases, a nest found in Springfield Township, there were 3 eggs of the warbler and 2 of the cowbird when the nest was discovered on May 30, 1952; by June 8 there were two young of each. The other instance was an observation in Clyde Township, July 3, 1954; a pair of golden-winged warblers was in attendance upon two recently fledged young of their own and one of the cowbird.

Elsewhere in its range, the golden-winged warbler has been reported as a victim on the basis only of single or very few records. In Massachusetts, J. A. Allen (1870, p. 576) recorded one instance. I have learned of but one other case from that state since then. Green (1928) reported one nest with 6 eggs of the warbler and 1 of the cowbird; he supplemented his record with the statement that he occasionally found cowbird eggs in nests of this species with smaller numbers of warbler eggs present. In Wisconsin P. R. Hoy (1885, pp. 102–103) reported a lone instance of cowbird parasitism. No further records for this state were published until 1947, when Robbins (1947) reported two parasitized nests discovered by Richter; a subsequent report (1949) gave still others. The cowbird involved in all the records is the typical race, *M.a. ater*.

Blue-winged Warbler

Vermivora pinus (Linnaeus)

The blue-winged warbler is a fairly frequent victim of the eastern race of the brown-headed cowbird, *M.a. ater*. Thirty-five definite instances have been noted, ranging from Connecticut, New York, New Jersey, Pennsylvania, Maryland, and Virginia to Ohio, Indiana, Michigan, Minnesota, Iowa, Missouri, and Alabama. In the summer of 1927 at Cold Spring Harbor, Long Island, New York, I found at least three pairs of blue-winged warblers feeding recently fledged cowbirds. As many as 4 cowbird eggs together with 2 of the host's, have been found in one nest: Bailey (1913, pp. 198–201) considered the former similar enough to have been laid by one female. Reiff (1893) reported a nest in Pennsylvania also containing 4 cowbird eggs and only 1 of the warbler.

One of the hybrids between this warbler and the golden-wing, the so-called Brewster's warbler, has been found to be a victim in at least one instance. Eames (1893, pp. 89–90), who removed the 2 cowbird eggs from the nest, reported this case from Connecticut.

Tennessee Warbler

Vermivora peregrina (Wilson)

This northern breeding warbler is a very uncommon victim of the cowbird. Two races of the latter, *ater* and *artemisiae*, have been known on a few occasions to lay in the warbler's nests. Brodkorb (1926, p. 249) noted a Tennessee warbler feeding a fledgling cowbird at Duck Lake, Muskegon County, Michigan, on July 12, 1923. T. E. Randall wrote to me many years ago that he had collected a parasitized set of eggs in Alberta. Rowan collected another parasitized set at Donatville, Alberta, on June 17, 1935, a set now in the collections of the University of Alberta. A third case was found

also in Alberta by Donald Wilby. Street (*in* Houston and Street, 1959, p. 176) discovered that this warbler was parasitized at Nipawin, Saskatchewan. Although these are all the records I have located, it appears that some earlier cases (or at least one) must have been reported but not published, since Oberholser included the Tennessee warbler within his list of cowbird hosts in his unpublished manuscript on the birds of Texas—a work written long before any of the above instances were observed.

Orange-crowned Warbler

Vermivora celata (Say)

The orange-crowned warbler has been recorded but once, to my knowledge, as a host of the brown-headed cowbird. A. R. Davidson (in litt.) informed me that on August 18, 1959, he saw one of these warblers (race *V.c. lutescens*) feeding a fledgling of the parasite (race *M.a. artemisiae*) in Vancouver Island, British Columbia. (For another, possible record see Wilson's warbler, p. 123.)

Nashville Warbler

Vermivora ruficapilla (Wilson)

The Nashville warbler and the brown-headed cowbird are relatively unimportant to each other as host and parasite. I have been able to learn of only 16 instances of cowbird parasitism on this species. The records come from Quebec, Massachusetts, New York, Michigan, Ontario, Minnesota, and Manitoba. In southern Quebec, over a period of nearly 60 years, Terrill (1961, p. 6) found 83 nests of the Nashville warbler, 6 of which, or a little over seven percent, were parasitized. While the total number, 6 nests in 60 years, is small as far as the cowbird is concerned, the percentage of victimized nests is high enough to be a factor, at least locally, in the economy of the warbler. In no other part of its range, however, has anyone found a comparable frequency of parasitism. In Massachusetts, a state where a great many observers have been working continuously for over a century, only three instances have been noted: J. A. Allen (1864, p. 60) found the first set of eggs near Springfield on June 5, 1863; on June 8, 1888, another set was collected near Farmington for the J. P. Norris collection; and on June 15, 1907, F. H. Carpenter collected the third set, now in the U.S. National Museum (Bent collection). From New York, another well worked state, I know of but a single record, a set collected at Holland Patent, on June 2, 1888, and now in the U.S. National Museum.

In Ontario, Lawrence (1948) watched a parasitized nest and found that eventually it produced a young cowbird together with two young warblers. This is the only observed case which resulted in the rearing

of the parasite by this host; the others were all egg records, collected when they first were found. Other Ontario records were reported by Baillie and Harrington (1937, p. 242) and by Snyder (1938, p. 203). Macoun (1909, p. 614) listed another Canadian record, near Ottawa, for June 1, 1899. All of these records refer to the eastern race, both of the host and of the parasite. Cartwright (1931, p. 185) reported a nest with 2 eggs of the warbler and 3 of the cowbird in Manitoba; there the parasite is of the race *artemisiae*.

In the Itasca State Park area of Minnesota, Hickey, Hofslund, and Borchert (1955) found two instances of cowbird parasitism on this warbler.

Virginia's Warbler

Vermivora virginiae (Baird)

This species only recently has been found to be molested by the brown-headed cowbird. A single record reports a nest seen by Cross (1950, p. 138) near Daniels Park, Colorado, in July 1949. Originally, when first found by Niedrach, the nest contained several eggs of the warbler and 1 of the cowbird (subspecies *artemisiae*), but when Cross was shown the nest on July 13, it contained only a well-grown young cowbird and a single, weak, little warbler. This is the same instance as the case mentioned by Bent (1953, p. 124).

Since the altitudinal range of Virginia's warbler largely is above that of the cowbird, such general allopatry probably reduces the incidence of parasitism on this host.

Lucy's Warbler

Vermivora luciae (Cooper)

The published data on Lucy's warbler indicate that, while there are very few records of cowbird parasitism on the species, locally this warbler may be imposed upon rather frequently. In the report on a collection of birds from Arizona, Brewster (1882, p. 85) mentions a young Lucy's warbler which was taken from a nest that also held a young cowbird (subspecies *obscurus*). Bendire (1895, p. 442) lists this warbler as a cowbird host—probably on the basis of Brewster's record. For a long time this was all that was known until Dawson (1923, p. 458) listed three cases in California and referred to the cowbird as a prominent enemy of this species. "Sometimes the warblers are able to entrench themselves behind apertures so narrow that the Cowbird cannot get in; and once we saw the Cowbird's foundling resting unharmed, but also harmless, upon the 'doorstep' not less than two inches distant from the warbler's eggs. Another nest, more exposed, contained three eggs of the arch enemy, and had been deserted by the troubled owners." More recently, Bull (1958, p. 394) observed a fledgling dwarf cowbird being fed by Lucy's warbler

in Hudspeth County, Texas, on June 8, 1958. R. S. Crossin (in litt.) informed me that on May 24, 1959, along San Pedro River, St. David, Cochise County, Arizona, he collected a set of 2 eggs of Lucy's warbler along with 1 of the dwarf cowbird. In the collections of the Santa Barbara Museum of Natural History there are two more parasitized sets of eggs, which were taken in 1917 near Tucson, Arizona; three similar sets formerly were in that museum.

Parula Warbler

Parula americana (Linnaeus)

The parula warbler seldom has been reported to be molested by the brown-headed cowbird. While this may be due in part to the observer's difficulty in finding the dainty, pensile nests of the host within the drooping masses of Spanish moss it prefers as a breeding site, the total number of the warbler's nests which have been found is large enough to indicate the low percentage of cowbird parasitism. It follows that neither the warbler nor the cowbird are important in the economy of the other. Altogether, only 12 records have been noted, distributed among the following states: Massachusetts, Connecticut, New York, New Jersey, Pennsylvania, Maryland, Virginia, Indiana, Alabama, Oklahoma, and Texas. The eastern race of the parasite, *M. a. ater,* is involved in all the records except for one instance: a parasitized nest collected by H. P. Attwater in Kerr County, Texas, in 1895, and now in the U.S. National Museum; in this case, it is the dwarf race, *M. a. obscurus,* which is involved. Many years ago, the late J. P. Norris informed me that he had an unusually large "set" of eggs taken in Northampton County, Virginia, May 27, 1890, by G. B. Benners, comprising 3 eggs of the warbler and 3 of the brown-headed cowbird.

Yellow Warbler

Dendroica petechia (Linnaeus)

The yellow warbler has been known for a long time as one of the most frequently imposed upon cowbird victims. The actual records which have been observed must be well over a thousand. I stopped accumulating them after I had noted more than 900 instances. All three races of the brown-headed cowbird and five races of the yellow warbler—*aestiva, amnicola, rubiginosa, morcomi,* and *sonorana*—are involved. The great mass of records come from practically every province of Canada and every state of the United States where the warbler and the cowbird both occur as breeding birds.

In recent years, studies of the yellow warbler have yielded important quantitative data on the relations between it and the cowbird. Hicks (1934, pp. 385–386), in Ohio, found 62 out of 146 nests to be

parasitized, a percentage of 42. Berger (1951a, p. 29), in Michigan, recorded 18 parasitized nests out of 44 nests, or 40.9 percent. Terrill (1961, p. 6) found that 42 out of 307 yellow warbler nests in southern Quebec were parasitized, an incidence of parasitism of 13.6 percent. The data assembled in the Detroit area in 1954 (Detroit Audubon Soc., 1956, p. 90) reveal that, of 208 nests of the yellow warbler reported in 1954, 74, or 35.6 percent, were parasitized. In the preceeding year the percentage of parasitism had been 31.2 percent. The percentage varies locally within the "Detroit area," which includes eight counties of southeastern Michigan and adjacent Ontario. For example, in the Cranbrook Area in 1953, 21 of 49 nests, or 42.8 percent, were parasitized, but in 1954, 29 of 49 nests, or 59 percent, were affected; at Rondeau Park in 1953, 6 of 45 nests, or 13.3 percent, had cowbird eggs or young, whereas in 1954, 27 of 84, or 32.1 percent, were so recorded; at Otter Lake in 1953, 15 of 42 nests, or 35.7 percent, were parasitized, but in 1954, 7 of 23, or 30.4 percent, were affected; at Pontiac Lake in 1953, 7 nests were found, not one of which had been molested, but in 1954, 1 nest out of 18, or 5 percent, was parasitized. The overall average frequency of parasitism for five years in the "Detroit area" was 37.1 percent of the nests which were found.

The situation at Pontiac Lake is of interest. The apparent freedom from cowbird attention which the yellow warblers seem to enjoy there appears to be explained by the fact that nearly all the nests which were found were situated in, or close to, colonies of redwinged blackbirds. The latter, with their aggressive dispositions, act as a deterrent to intruding cowbirds, and, furthermore, cowbirds are less liable to use nests in marshy areas, where the redwings nest. Sutton (1928, p. 163) found at Pymatuning Swamp, Pennsylvania, that redwings refused to tolerate cowbirds in their breeding area. He saw "a flock of Red-wings once pursue a female Cowbird until she was utterly exhausted and plunged into the water to escape. Her pursuers chased her to the edge of the Swamp then headed her off and forced her to the opposite bank."

Although the yellow warbler is, in many cases, a tolerant host, accepting the parasitic eggs and rearing the emergent young, it often does eliminate the foreign eggs by building a new lining or a new nest floor over them and leaving them buried in the structure.

Perhaps an extreme instance of this tendency is a case reported by Schrantz (1943), who studied 41 nests of this warbler in two successive summers at West Okoboji Lake, Iowa. Of the 41 nests, 12 were parasitized, and 11 of the 12 had cowbird eggs buried under the nest lining. In some of these nests the foreign eggs were so deeply buried

that it seemed they probably were deposited before the completion of the original nest lining.

Other species of victims have been known to do this also, but none to the extent of the yellow warbler. The situation may be described as follows.

If a cowbird's egg is deposited in an empty nest before the warbler has laid any of its own, the strange egg frequently is buried under a new floor, but not infrequently the nest may be deserted and a completely new one built. If, however, the warbler has laid even 1 egg prior to the cowbird's egg being introduced into the nest, the host usually accepts and incubates the strange egg along with its own. Sometimes it buries the eggs, its own included, in what seems an effort to get rid of the foreign egg. The bird also may desert the nest.

It sometimes happens that, after building a new floor to the nest, the warbler again is parasitized. A great deal of variation arises in the reactions of the victim to such conditions. Usually, if there are several eggs of its own in the nest, the warbler will tolerate the cowbird egg and will incubate. If the cowbird should lay first, the warbler either may desert or build a new nest floor. There are numerous records of two-, three-, four-, and even five-storied nests of the yellow warbler, each of the lower stories containing eggs of the cowbird and, in some, eggs of the warbler as well. Berger (1955, p. 84) has reported what must be a record case: a six-storied nest with a total of 11 cowbird eggs buried in the various layers. As many as 4 eggs of the warbler, a complete set, have been found buried with 1 of the cowbird, but such extreme cases are rare. It is very uncommon to find more than 1 or 2 eggs of the warbler covered over in this manner.

Near Pontiac, Michigan, the McGeens (in litt.) found 40 parasitized nests of the yellow warbler. In 13 of these, the warblers had covered over the alien eggs with new floor lining; in 13 others, the nests were deserted after being parasitized; of the other 14, 6 met with failure because of predation and 9 carried through to fledging success. Recently, Berger (1961, p. 273) reported that, in the McGeens' study, the synchronization of the cowbird eggs with those of the yellow warbler (i.e., the time of deposition in the nests) was important; it was found that 86.5 percent of non-synchronized cowbird eggs were covered over or deserted, but only 22.5 percent of well-synchronized ones were treated thusly.

One of the older records of cowbird parasitism on the yellow warbler merits some mention. Savage (1895, p. 13) reported one of these warblers feeding a fledged cowbird in Iowa on October 2, 1893. If this is correct, which is highly doubtful, it is an unusually late date for both the parasite and the host. Bent (1953, p. 182) gives no egg dates for the warbler later than June 8 in the central United States.

Magnolia Warbler

Dendroica magnolia (Wilson)

The magnolia warbler has been recorded rather seldom as a cowbird victim, a fact which suggests that probably it is parasitized infrequently. Eaton (1914, p. 410), however, wrote that the cowbird "seems to make a specialty of presenting this Warbler with one or more of its eggs, generally puncturing the eggs of the Magnolia before leaving the nest." Unfortunately, Eaton did not support this statement with explicit data, and such evidence has not been found in the literature. Higgins (1894, p. 106) collected a parasitized nest near Cincinnatus, New York, and a second set that later became part of the J. P. Norris collection. Other parasitized sets of eggs are in the collections of the American Museum of Natural History and the Chicago Natural History Museum. The late H. Mousley wrote to me that he had found a cowbird's egg in a magnolia warbler's nest near Hatley, Quebec. All in all, only 17 records have been noted, ranging from Quebec, Prince Edward Island (Mills, 1958), Ontario, and Saskatchewan to Massachusetts, New York, Pennsylvania, Michigan, and Minnesota. In southern Quebec, in the course of almost 60 years, Terrill (1961, p. 7) found 147 nests of this warbler, of which 6 contained cowbird eggs.

All the records refer to the nominate, eastern race of the brown-headed cowbird, except one from Saskatchewan, wherein the race *artemisiae* is involved. This was found by Street (*in* Houston and Street, 1959, p. 159) at Nipawin, Saskatchewan, on June 27, 1934.

Cape May Warbler

Dendroica tigrina (Gmelin)

Many years ago, the late J. H. Bowles wrote to me that he had a distinct recollection of having seen a set of eggs of this warbler containing one of the cowbird, but he could not recall where or when it was collected or in whose collection it was when he saw it. Because of this lack of precise data I have kept this statement in my unpublished notes, waiting for a more completely documented case, but no other instance has yet been reported. Without a specified locality, one cannot say which of the two possible races of the cowbird was involved. Since the Cape May warbler nests high up in evergreen trees, it is not likely to be recorded to any extent as a cowbird host.

Black-throated Blue Warbler

Dendroica caerulescens (Gmelin)

This is a very infrequent host of the brown-headed cowbird. Only 10 records have been noted—distributed from Ontario and Quebec to Rhode Island and New York. Hathaway (1913, p. 557) saw a female

black-throated blue warbler feeding a young cowbird much larger than she was. Kells (1887, and 1902) recorded two parasitized nests in Ontario; another Ontario record is a parasitized nest found by Saunders at Durham, Gray County, on June 22, 1909, and reported by Baillie and Harrington (1937, p. 245). In New York, W. L. Ralph collected three such nests, which are now in the U.S. National Museum. Terrill (1961, p. 7) discovered three instances of cowbird parasitism in seven nests which were found in southern Quebec in the course of nearly 60 years of observation in that region. All the records involve the nominate race, both of host and parasite.

Myrtle Warbler

Dendroica coronata (Linnaeus)

The myrtle warbler is a commonly utilized host in southern Canada, but seldom has it been recorded elsewhere in this capacity. It has been noted as a victim of the cowbird in Alberta, Saskatchewan, Ontario, Quebec, Maine, Michigan and Wisconsin. Dr. Paul Harrington wrote to me that near Wasaga Beach, South Georgian Bay, Ontario, he examined 38 nests, no less than 25 of which contained eggs of the cowbird; 20 nests had 1 parasitic egg; three had 2 each; and two had 3 each. One nest had a cowbird's egg imbedded in its side, where the warbler had built a new nest lining over the egg. Bent (1953, p. 250) quotes Harrington that "it would not be exaggerating to say that two-thirds of the initial nests are parasitized. The egg or eggs of the cowbird are often deposited before the nest is completed, leading to many a deserted nest. Twice I have found a cowbird's egg imbedded, as so often happens in the yellow warbler's nest, but in both cases yet another was in the nest with the owner's. Twelve percent of the nests with eggs of the cowbird were deserted, but none in which the owner's eggs were also present. Generally but one of the parasite's eggs was found, occasionally two and rarely three."

Bent cites F. A. E. Starr as saying that, of 30 nests examined, he had yet to find one which did not contain from 1 to 3 eggs of the cowbird. In southern Quebec, out of a total of 33 nests examined, Terrill (1961, p. 7) noted two instances of cowbird parasitism on this warbler.

In Maine, Knight (1908, pp. 341–342) listed the myrtle warbler as a local cowbird host, and C. H. Morrell collected a parasitized set of eggs at Pittsfield, on May 26, 1891. This set, now in the U.S. National Museum, may have been the basis for Knight's statement. In Michigan, Van Tyne (1924, p. 169) found a parasitized nest near Hessel, Mackinaw County, on June 20, 1919, and Root (1942) observed a pair of myrtle warblers feeding a fledgling cowbird. The foregoing records all involve the eastern race of the cowbird.

The northwestern race, *M.a. artemisiae*, has been found to parasitize the myrtle warbler in Alberta and Saskatchewan. T. E. Randall informed me that on May 27, 1934, he found a nest at Boyle, Alberta, containing 4 eggs of the warbler and 1 of the cowbird. At Winterburn, Alberta, a set of 3 eggs of the warbler with 1 of the cowbird was collected; the set is now in the Rowan collection at the University of Alberta. Godfrey (1950, p.79; 1952, p. 166) noted fledgling cowbirds attended by myrtle warblers at Grimshaw, Alberta, and at Flatten Lake, Saskatchewan. Gunn (1956, p. 88) noted that a pair of myrtle warblers at Spirit Lake, Saskatchewan, raised 2 of their own young and 1 cowbird. Street (*in* Houston and Street, 1959, p. 176) found this warbler to be victimized at Nipawin, Saskatchewan. Bent (1953, p. 250) records two Alberta records sent to him by A. D. Henderson. It now appears that the molestation of the myrtle warbler occurs regularly throughout its range without regard to the subspecies of the parasite.

All records refer to the typical race of the myrtle warbler.

Audubon's Warbler

Dendroica auduboni (Townsend)

This warbler is known as a cowbird victim on the basis of only four instances. E. M. Tait (Friedmann, 1934, p. 36) found that it was parasitized at Trout Creek Point, British Columbia. Cowan (in litt.) wrote to me that a parasitized nest had been found at Lumby, British Columbia. Rogers (1955, p. 392) recorded a similar instance at Cromwell Island, Flathead Lake, Montana. Finally, an egg of the brown-headed cowbird taken from a deserted nest of this warbler at Mammoth Camp, Mono County, California, on July 3, 1922, was sent to the Santa Barbara Museum of Natural History. All four records involve the cowbird race *artemisiae*, but they refer to two races of the host—*auduboni* in British Columbia and California, and *memorabilis* in Montana.

Black-throated Gray Warbler

Dendroica nigrescens (Townsend)

The black-throated gray warbler is a species that has been studied very little; correspondingly, its relations with the brown-headed cowbird are documented poorly. There are three pertinent observations. Marshall (1957, p. 112) found this warbler to be a victim of the local race of the cowbird, *obscurus*, in the pine-oak woodlands of southern Arizona, and Bent (1958, p. 454) noted that Hanna had collected a parasitized set of eggs in San Bernardino County, California. Recently, T. D. Burleigh has informed me that at Oakley, Cassia County, Idaho, on July 20, 1958, he noted a male black-throated

gray warbler feeding a fledgling cowbird; this record, on geographic grounds, must refer to the cowbird race *artemisiae*.

Black-throated Green Warbler

Dendroica virens (Gmelin)

This warbler appears to be a very infrequent victim of the brown-headed cowbird. Only 15 definite records have been reported, five from Michigan, two each from Ontario, Quebec, Maine, and New York, and one each from Minnesota and Ohio. All the records refer to the nominate race of both host and parasite. Bicknell (1882, p. 159), on the authority of John Burroughs, listed the black-throated green warbler as a cowbird victim in the Catskill Mountains of New York. A little to the northwest, at Ithaca, New York, on July 3, 1922, I watched a recently fledged cowbird being fed by one of these warblers. Mendall (*in* Palmer, 1949, p. 515) found a parasitized nest at South Thomaston, Knox County, Maine, on July 13, 1936. Swain (1899a, p. 33) found several nests of this warbler in Maine, of which one was parasitized by the brown-headed cowbird. In southern Quebec, Terrill (1961, p. 7) reported two cases out of a total of 16 nests examined; in Ontario, Harrington found two cases near Wasaga Beach, South Georgian Bay, which I reported in an earlier paper (1938, p. 48). Wikerstrom (1953, p. 147) saw a pair of these warblers feeding two recently fledged cowbirds at O'Reilly, St. Clair County, Michigan, on July 12, 1953; Wallace (1945, p. 174) and Pitelka (1940) recorded still other cases of cowbird parasitism on this species in Michigan. Guttman (1956, p. 136) noted one of these warblers feeding two recently fledged cowbirds in Clearwater County, Minnesota, on August 7, 1955. The first naturalist to record the black-throated green warbler as a cowbird host was Krider (1879, p. 51), who, unfortunately, gave no locality for his record.

Golden-cheeked Warbler

Dendroica chrysoparia Sclater and Salvin

The golden-cheeked warbler has a very limited breeding range, comprising a few counties in south-central Texas, but there it has been recorded as a victim of the small race of the brown-headed cowbird, *M.a. obscurus*. In all, nine definite instances of parasitism have come to my notice. These nine do not include a statement by Strong (1919, p. 181), who noted a parasitized nest, supposedly of this species, collected on June 6, 1894, at Fort Small, Arizona, with 3 eggs of the warbler and 1 of the cowbird. Since the golden-cheeked warbler is not known to breed in Arizona, there seems to be a misidentification here. In the J. P. Norris collection there were three parasitized sets of eggs taken in Comal County, Texas. Three other instances—from the

files of the U.S. Fish and Wildlife Service—were reported by H. Lacey from his ranch at Turtle Creek, Kerr County, Texas: on June 14, 1900, two warblers were seen feeding a young cowbird in a wall nest near a house (a very young golden-cheeked warbler in the same tree probably was reared with the cowbird although the adult warblers were not seen actually to feed it); on May 15, 1905, a nest with 2 eggs of the warbler and 1 of the cowbird was found; on April 26, 1915, another nest with similar contents was discovered. Brewster (1879, pp. 77–79), reporting on Werner's data from Comal County, Texas, mentions a nest with 3 eggs of the warbler and 1 of the cowbird. A few days earlier, the same collector had seen a pair of golden-cheeked warblers with a brood of fledglings, among which were young cowbirds. Nyc (in litt.) collected a set with 1 egg of this warbler plus 3 of the dwarf race of the cowbird.

Hermit Warbler

Dendroica occidentalis (Townsend)

It is not possible to estimate the relations between the hermit warbler and the brown-headed cowbird. Not only is the former a seldom studied species, but also only a single instance of cowbird parasitism has been reported. Reynolds (1942, p. 28) saw a fledgling cowbird (race *obscurus*) being attended and fed by a pair of hermit warblers at Camp Augusta, three miles from Nevada City, California, on June 21, 1942.

Cerulean Warbler

Dendroica cerulea (Wilson)

The cerulean warbler is an uncommon victim of the brown-headed cowbird. Because it builds high in trees, its nests rarely are discovered. While this fact may tend to keep down the recorded number of instances of cowbird parasitism, enough nests have been collected over the years to make meaningful the paucity of cowbird records. Only 12 instances have been noted. They are distributed from Ontario to Michigan, Indiana, New York, Pennsylvania, and Virginia. Saunders (1900, p. 361) reported two parasitized nests from western Ontario. The late J. P. Norris informed me many years ago that there were three parasitized sets of eggs from Ontario in his collection, but whether these included any of those listed by Saunders is not clear. Dickey (1912, p. 302) noted a case in Greene County, Pennsylvania. In the Bent collection in the U.S. National Museum there is a parasitized set collected at Tonawanda Swamp, New York, on June 1, 1900. In the same collection there are two similar sets—one from Saginaw, Michigan, taken by R. A. Brown, on June 23, 1900, and one from Beaver County, Pennsylvania, collected by W. E. C. Todd. Flint (1892) recorded a set of eggs of the cerulean warbler with a cowbird's

egg but, unfortunately, he gave neither locality nor data of collection. On June 28, 1952, at Pontiac Lake, Michigan, a female cerulean warbler was observed feeding a recently fledged cowbird along with a fledgling warbler (Detroit Audubon Soc., 1953, p. 72). The southernmost record comes from southwestern Virginia, where Jones (1936, p. 88) found a parasitized nest. The nominate race of the cowbird is involved in all these records.

Blackburnian Warbler

Dendroica fusca (Müller)

This is a very uncommon host of the brown-headed cowbird. In my first account of the bird (1929, p. 245), I listed four cases; in more than 30 years since then, I have learned of only six others—testimony in itself, to the very slight incidence of parasitism on the blackburnian warbler. The records are from New York, Michigan, Minnesota, and Ontario.

Apparently on the basis of a note from Dr. Brewer, Audubon (1839, p. 491) was the first to record this warbler as a victim of the cowbird. Brewer (*in* Baird, Brewer, and Ridgway, 1874, pp. 154–157) included this bird in a list of species in whose nests he had found cowbird eggs. Merriam (1885, p. 103) reported a nest, 84 feet from the ground in a tall tree in the lower Hudson Valley, New York, containing 4 eggs of the warbler and 1 of the cowbird. This is the "altitude record" for a cowbird's egg.

According to Roberts (1932, pp. 229–231), S. A. Grimes found a nest in Cass County, Minnesota, on June 22, 1929, with 2 eggs of the warbler and 2 of the cowbird, and another nest with 3 eggs of the host and 1 of the parasite. Another Minnesota record (from a note in files of U.S. Fish and Wildlife Service) states that E. D. Swedenborg watched a blackburnian warbler feeding a recently fledged cowbird near Minneapolis on July 15, 1928.

A similar record from an area near Ottawa, observed by Taverner, was mentioned by Lloyd (1944, p. 169); Snyder (1942, p. 144) noted a parasitized nest found by Shortt in the Sault Ste. Marie Region of Ontario.

Preston (1889) recorded a nest with 2 newly laid eggs of the owner and 1 of the cowbird, and "at the foot of the tree were fragments of two more eggs which had been crowded from the nest by this parasite." He also recorded another nest with 3 eggs and "with one of the inevitable cowbird."

Wood (1957, p. 394) reported a nest with 4 eggs of the warbler and 1 of the cowbird, near Kalamazoo, Michigan.

The records all refer to the eastern race of the cowbird.

Yellow-throated Warbler

Dendroica dominica (Linnaeus)

The yellow-throated warbler is known as a host of the cowbird (typical race) only in Oklahoma and on the basis of single record: a parasitized nest found by T. R. Beard (*in* Nice, 1931) at Sapulpa, Creek County. The warbler involved is the race *albilora*. The absence of additional instances is difficult to explain as this warbler seems to be a suitable host and the cowbird is common in the same areas.

Grace's Warbler

Dendroica graciae Baird

This is another rarely reported cowbird victim about which it is premature to form an estimate. Three instances of cowbird parasitism have been reported. The late J. P. Norris informed me that in his collection he had a set of 3 eggs of the warbler and 1 of the cowbird, taken by O. W. Howard in the Chiricahua Mountains, Cochise County, Arizona, on June 23, 1900. Marshall (1957, p. 112) saw Grace's warbler feeding a fledgling cowbird in the pine-oak woodlands of southern Arizona. Sheppard (1959) found a cowbird's egg in a nest of this warbler in McKinley County, northwestern New Mexico. This record, on geographic grounds, must be referred to *M.a. artemisiae* the two Arizona instances are *M.a. obscurus*.

Chestnut-sided Warbler

Dendroica pensylvanica (Linnaeus)

The chestnut-sided warbler is a frequent victim of the brown-headed cowbird (races *ater* and *artemisiae*). Over 75 definite records have been reported, distributed among three provinces of Canada—Saskatchewan, Ontario, Quebec—and the following of the United States: Maine, Massachusetts, Connecticut, New York, New Jersey, Pennsylvania, and Maryland to Ohio, Michigan, Minnesota, Iowa, and Nebraska. The one record from Saskatchewan, a nest containing 1 egg of the warbler and 1 of the cowbird, which was found at Nipawin, on June 24, 1941 by Street (*in* Houston and Street, 1959, p. 161, 176), is the only record for the cowbird race *artemisiae;* all the others involve typical *ater*. In southern Quebec, Terrill (1961, p. 7) found 55 nests of this warbler during about 60 years of field observation, and of these, 16, or 29 percent, contained eggs of the cowbird. This is a higher incidence of parasitism than has been reported in most other parts of the common range of the warbler and the cowbird. In a much smaller series of nests in Ohio, Hicks (1934) found four cases of parasitism in 12 nests, or 33.3 percent.

At Ithaca, New York, I observed three parasitized nests and found the chestnut-sided warbler to be a tolerant host, accepting, incubating,

and rearing the parasites. Occasionally, however, it has been known to bury cowbird eggs if the latter are laid first. Sage and Bishop (1913, pp. 110–111) in Connecticut recorded such a case: a nest containing 4 eggs of the warbler and 1 of the cowbird, which was buried under a new nest lining. The nest had been observed previously for over a week, and the cowbird's egg was known to have been laid before any of the warbler's. Mercer (1911) reported a double-storied nest of this warbler with a buried cowbird egg in the lower portion. Terrill found that, while this warbler was a frequent host, it was not always submissive. Six nests, in which the cowbird had laid before the owner, were destroyed, and in a seventh, the parasitic egg was buried partly in the nest lining.

Bay-breasted Warbler

Dendroica castanea (Wilson)

This northern breeding warbler is geographically and ecologically sympatric with the brown-headed cowbird only to a limited degree, a factor which undoubtedly helps to protect it from parasitism. There are, however, two records—both observed by F. Napier Smith, who reported the first (1951, p. 44) from Kamouraska, Quebec, about 150 miles north of the latitude of Montreal, on July 2, 1951; the nest contained 2 eggs of the warbler and 1 of the cowbird. The second nest, from the same area, was found on June 18, 1952, about 60 feet from the site of the first one, according to Terrill (1961, p. 8).

Pine Warbler

Dendroica pinus (Wilson)

The brown-headed cowbird seldom inflicts its eggs upon the pine warbler. Only 10 records—from Ontario, New York, New Jersey, Michigan, Wisconsin, and Minnesota—have been noted. At Ithaca, New York, on June 29, 1921, I watched a pine warbler feeding a young cowbird at the foot of a tree in which there was a nest some 60 feet from the ground. Since only one pair of pine warblers was in the immediate vicinity and previously I had heard cowbird-like food cries from the upper part of this tree, it seemed fairly certain that the young cowbird came from that nest. No young pine warblers were seen. Eaton (1914, p. 429) reported a nest, also in New York, with 3 eggs of the host, 1 egg of which was punctured, and 1 of the cowbird. Ord (1836, p. 59) found a parasitized nest in New Jersey in May, 1813. Wood, Smith, and Gates (1916, p. 14) saw a pine warbler feeding a fledged cowbird in Cheboygan County, Michigan. Recently, other Michigan records have become available. Wickerstrom (1953, p. 147) noted one instance in the Port Huron game area on July 5, 1953, and Walkinshaw (1952, p. 96) found two

parasitized nests. The Ontario records, two in number, were found near Wasaga Beach, South Georgian Bay, by Dr. Paul Harrington. All the records refer to the nominate race of both warbler and cowbird.

Kirtland's Warbler

Dendroica kirtlandii (Baird)

Kirtland's warbler is a species, perhaps the only one, the survival of which is seriously threatened by the parasitism of the cowbird. As is well known, the breeding range of Kirtland's warbler is extremely small, being limited to stands of small jack-pine in a few counties of north-central Michigan; the cowbird probably extended its range into this area after 1875 and it has increased rapidly there ever since.

The earliest record I have found involves a parasitized nest discovered in Crawford County on May 31, 1908, by Strong (1919, p. 181). Barrows (1921) in Iosco County found a parasitized nest containing 1 egg of the warbler and 3 of the cowbird while a 4th cowbird egg lay on the ground just outside the nest. Subsequently, the warbler laid another egg, and 1 of the cowbird eggs disappeared. Shortly thereafter, Barrows wrote me that his "correspondence with several collectors indicates that bird is frequently victimized; in fact, I believe the cowbird is one of the most serious enemies of this species." A. K. Fisher collected another heavily infested nest, with 1 egg of the warbler and 4 of the cowbird, about 15 miles east of Grayling, on June 13, 1923; the set is now in the U.S. National Museum. Leopold (1924, p. 53), like Barrows, concluded that the brown-headed cowbird was a major reason for the numerically low status of Kirtland's warbler.

The recent publication of Mayfield's meticulous and exhaustive study (1960) of this warbler not only makes incomplete all earlier statements about its relations with the cowbird, but also provides us with the most critical evaluation of host-parasite relations we have for any of the cowbirds' hosts. The interested reader should consult Mayfield's book (especially pp. 144–181) for fuller details than can be given here.

Kirtland's warbler has this peculiarity as a cowbird host: it is victimized very frequently, but the area in which it breeds is extremely limited, with the result that a mere enumeration of the known instances of parasitism means very little when compared with those of a wide-ranging but less intensively imposed upon species. Furthermore, since the parasite is a recent invader in the breeding range of this warbler, the latter has not been able to develop any effective defenses against its new enemy.

Mayfield reported that, of 137 complete sets of Kirtland's warbler eggs, 75 sets, or 55 percent, contained 1 or more cowbird eggs. Up

to 4 cowbird eggs were found in individual nests; the average number of cowbird eggs was 1.67—with 1.89 fewer warbler eggs in the parasitized nests than in unmolested ones. Hence, it follows that 1.13 warbler eggs were removed for each cowbird egg laid. "The loss of warbler eggs in parasitized nests was 41 percent of the eggs laid; the loss in all nests, 55 percent of them parasitized, was 25 percent of warbler eggs laid—these losses from egg removal alone."

Mayfield's calculations showed that it is not only in the matter of host egg removal that the parasite exerts a heavy toll, but also in the fact that this continues at all stages of the breeding process. "The probability that eggs present at hatching time will hatch is 85 percent among warbler eggs alone, but 75 percent with cowbird eggs present; the rate is lower in nests with several cowbird eggs than in nests with only one. The presence of young cowbirds in the nests reduces by .55 the probability that warblers will be fledged. The presence of two or more cowbirds hatched ahead of the warblers is lethal to the warbler nestlings." Mayfield's figures suggest that Kirtland's warbler, as a total species, would produce annually about 60 percent more fledglings of its own kind if there were no interference from the parasite.

Mayfield summarized (p. 176) the losses suffered by Kirtland's warbler through cowbird parasitism as follows: 41 percent of the total warbler eggs laid were removed by the cowbird; 10 percent of the warbler eggs present at hatching time failed to hatch as a result of the cowbird eggs present (as estimated from the excess over hatching failures in nonparasitized nests), which, if calculated as percentage of warbler eggs laid, is 6 percent; 59 percent of the warblers hatched are not fledged because of cowbird nestlings present (again, as estimated from excess over nestling loss in nonparasitized nests), which figure is 31 percent of the original total warbler eggs laid. In other words, 41 percent+6 percent+31 percent, or 78 percent, of all warbler eggs laid in nests which were parasitized by the cowbird failed to produce fledglings. Since 55 percent of all Kirtland's warbler nests were parasitized, the cowbird was responsible for the loss of about 43 percent of all Kirtland's warbler eggs in nests not abandoned or destroyed. If this is added to the other perils which the warbler has to face, such as accidents to one or both of the adult birds, flooding of the nests, nest predators, all of which, according to Mayfield's data, cause the loss of two-thirds of Kirtland's warbler nests, one can see that cowbird parasitism is an insupportable affliction.

When we consider the limited population of Kirtland's warbler in its entirety, estimated in 1951 as comprising only one thousand adult birds, and its strict dependence on a specialized and decreasingly available type of nesting habitat, the added impact of the brown-

headed cowbird upon it is such as to endanger its continued existence. No other species is so heavily parasitized with such disastrous results over its entire population. Unless something happens, or is done, to reduce, if not to eliminate, the cowbird menace, the future of Kirtland's warbler is perilously insecure.

Only a few years ago, however, Van Tyne (*in* Bent, 1953, p. 426) wrote that, while the cowbird was a most important enemy of Kirtland's warbler, there was no reason to think that the parasite might bring about its extinction, as Leopold had feared. Van Tyne thought that it was more probable that the observed changes in the population size of the warbler were the result of changes in the amount of suitable habitat for it in its breeding grounds in Michigan or in its wintering area in the Bahamas. Nevertheless, the alarming interpretation of cowbird parasitism presented by Mayfield certainly suggests that the losses caused thereby have brought Kirtland's warbler to a situation perilous to its continuity. Here is a case wherein the parasite, as a new enemy in the environment of the warbler, has "gotten out of hand," and should be controlled, if not eliminated locally.

Van Tyne has added some further observations on the relations between this host and the parasite. He saw a female cowbird spend hours apparently watching a female Kirtland building its nest. When the warbler was not actually working on the nest, the structure was left unguarded, and, "as soon as the main structure was finished—even before the lining was added—a cowbird (presumably the one that had been watching the nest-building) came early in the morning and laid in it. After watching many hours at recently completed, or nearly completed, Kirtland nests, I would judge that cowbirds laying in a Kirtland's nest during this early part of the cycle, which is the period most favorable for the cowbirds' chances of producing young, run very little risk of detection and attack. But after the warbler has begun incubation, the nest is rarely left unguarded, and the female warbler will attack violently and drive away any cowbird she finds in the vicinity."

Although the cowbird is a major calamity to Kirtland's warbler, the latter, in turn, must certainly be rated as a good or successful host from the standpoint of the parasite. Based on his large amount of data, Mayfield (p. 179) estimated that about 41 percent of all cowbird eggs laid in nests of this host would survive to produce fledglings. This is a very high rate, which in itself adds yet another element to the danger facing Kirtland's warbler. While it can be argued that the parasite's success may be of temporary duration since it may decimate its host to the point of eliminating its own supply of victimizable nests, such a result would involve the permanent

disappearance of Kirtland's warbler, after which the cowbird probably would turn to other hosts in the area.

Prairie Warbler

Dendroica discolor (Vieillot)

The prairie warbler is a bird whose relations with the brown-headed cowbird cannot be appreciated from the published data. When I first studied this warbler (1929, p. 246), I was led to consider it a very uncommon victim of the eastern race of the brown-headed cowbird; however, correspondence and discussions with experienced and reliable egg collectors since then indicate that in some localities the prairie warbler is a very frequently imposed upon host. Approximately 35 records have come to my notice, distributed from New York, Connecticut, New Jersey, Maryland, the District of Columbia, Virginia, North Carolina and Georgia to Tennessee, Arkansas, Missouri, Indiana, Michigan, and Ontario.

The most important study of this warbler and its relations with the cowbird is that made in Michigan by Walkinshaw (1959). He found 18 nests of the warbler, five of which contained cowbird eggs. In these 18 nests, 63 warbler eggs had been laid, from which hatched 31 young (49.2 percent), 20 of which (31.74 percent) lived to leave the nest. The five parasitized nests contained 6 cowbird eggs, of which only 1 produced a young cowbird that survived to the fledgling stage. It would appear from these data that the prairie warbler is not a host with which the cowbird is very successful, and also it would appear that the cowbird is not a great check on the increase of the warbler. Nolan (1958, p. 272) in Indiana suggests, however, that the presence of the young cowbird in a nest is serious, if not fatal, to the young warblers. He found the prairie warblers to be a frequent host and stated that the cowbird eggs "invariably hatched before those of the host. I have seen male warblers feeding cowbird nestlings before their own eggs had hatched, and this doubtless contributed to the usual quick starvation of the young warblers."

At Cape May, New Jersey, Stone (1940, p. 877) noted two parasitized nests found by Turner McMullen. He considered the prairie warbler one of the favorite hosts of the cowbird in that locality.

According to Bailey (1925, p. 129), this warbler has been known to build a new nest floor or lining over a cowbird's egg and any of its own that may be present and then start a new clutch.

All the records refer to the nominate race of warbler and cowbird.

Palm Warbler

Dendroica palmarum (Gmelin)

The palm warbler rarely is victimized by the brown-headed cowbird. Only seven instances have come to my attention. They involve two

races of the warbler, *palmarum* and *hypochrysea*, and two of the parasite, *ater* and *artemisiae*. Knight (1906) recorded a nest found by Morrell near Pittsfield, Maine, with 2 eggs of the warbler and 2 of the cowbird. Strong (1919) found a nest with a similar combination of eggs at Penobscot, Maine. Morrell collected a nest with 1 cowbird egg and 2 warbler eggs at Pittsfield, Maine, on May 27, 1891, a set now in the U.S. National Museum. Clayton (1914) found another nest with 1 cowbird egg and 2 warbler eggs; unfortunately, the locality for this record was not reported.

The above instances relate to the so-called yellow palm warbler (*hypochrysea*) and the eastern form of the cowbird. Two parasitized nests of the western race of host (*palmarum*) and parasite (*artemisiae*) were found in Alberta by T. E. Randall, who kindly informed me of the records. In the collections of the Carnegie Museum there is a set of 2 eggs of the palm warbler and 1 of the cowbird, collected at Fawcett, Alberta, on June 3, 1941.

Ovenbird

Seiurus aurocapillus (Linnaeus)

The ovenbird is a very frequent host of the brown-headed cowbird, and, in this respect, it is something of a puzzle. As a rule, the cowbird seldom bothers forest birds but prefers open nests built in open country. The ovenbird is strictly a bird of the forest floor, building a covered nest, and yet it is victimized very commonly. Over 280 records have been noted, distributed among provinces of Canada—Alberta, Saskatchewan, Ontario, and Quebec—and the following of the United States: Massachusetts, Connecticut, New York, New Jersey, Pennsylvania, Ohio, Indiana, Illinois, Michigan, Minnesota, and Iowa. All the records relate to the nominate race of the ovenbird; those from Alberta and Saskatchewan involve the western race of the cowbird, *artemisiae;* all the others, the eastern race, *ater.*

The extent to which the ovenbird is victimized in some parts of its range is shown in the data produced by Hann (1937, p. 213) in Michigan. Out of all the nests which received eggs, 52 percent were parasitized by the cowbird. Of the total number of ovenbird eggs laid, 63.4 percent hatched and 43.5 percent fledged. The greatest loss was due to predators; but the next greatest loss, to cowbirds, estimated as being responsible for the loss of 18 percent of ovenbird eggs and young. The chief loss was due to the removal of eggs by the cowbird. Out of 40 cowbird eggs, however, only 22 hatched, 10 fledged, and probably not more than 5 survived to leave the woods in which they were born. In light of these data, the ovenbird does not appear to be a particularly favorable host for the parasite when compared with the song sparrow, for instance, or the red-eyed vireo.

In later studies of the ovenbird and the cowbird, Hann (1941, p. 212) found a loss of 30 eggs of the host which was attributable to the females of the parasite and, in addition, the loss of 4 cowbird eggs which were removed in error by the parasite itself. Some 40 cowbird eggs were laid, which made the loss of the host's eggs to be 75 percent of the "gain" in parasitic eggs and made the total loss to be 85 percent of all the eggs laid. In only one parasitized nest was the full number of laid eggs retained. Hann found that the earliest ovenbird nests of the season were parasitized more heavily than the later ones.

In Ohio, Hicks (1934) found 112 nests, of which 41, or 36 percent, were parasitized; in southern Quebec, only 6 out of 61 nests reported by Terrill (1961, p. 8) had cowbird eggs in them. Many years ago, Lynds Jones (1888, p. 133) wrote that, in his experience in Ohio, "never yet has a nest been found here but two or more cowbird's eggs completed or completely made up the set. In one nest I found only three cowbird's eggs nearly hatched; in another three of the cowbird with one of [the ovenbird] . . . another contained four of the cowbird with two of the parent bird, and another . . . just five cowbird eggs." In the J. P. Norris collection there were no less than 25 parasitized sets of eggs from Pennsylvania. Sage and Bishop (1913, p. 160) observed in Connecticut that 11 nests were parasitized, out of 30 examined.

In the local studies referred to above, we find the percentage of parasitized nests to vary from 33 in Connecticut to 36 in Ohio and 52 in Michigan. If we add the six major studies, we find that, out of 209 active nests, a total of 89, or about 42.5 percent, were parasitized.

Ovenbirds have been known to successfully rear the young parasites; they are usually very tolerant of cowbird eggs, provided that the number present is not excessive. As many as 8 cowbird eggs have been reported in a single nest of the ovenbird by Mikesell (1898) in Ohio. A nest with 7 cowbird eggs was reported by Hess (1910).

Northern Waterthrush

Seiurus noveboracensis (Gmelin)

The northern waterthrush is generally an infrequently used host, but there is some local variation in this regard. Only 15 records have come to my notice, involving two races of the warbler, *noveboracensis* and *notabilis*, and one of the cowbird, *ater*. The reported instances are from Quebec, Ontario, New York, Michigan, and Iowa. The only place from which a fairly high incidence of cowbird parasitism has been reported is southern Ontario, where Allin and Harrington (*in* Griscom and Sprunt, 1957, p. 196) found that 8 out of 40 nests

examined contained cowbird eggs. This is more than half of all the cases noted. The reasons for this local difference (if there is a real difference in the facts and not in the intensiveness of the observational field work) are not readily apparent.

Mr. John B. Hurley informed me that Dr. F. A. Starr collected a parasitized set of eggs of this warbler at Sturgeon Lake, Ontario. Bendire was the first to list the northern waterthrush as a cowbird victim but he gave no specific records. However, since this was earlier than any of the published instances, it seems to follow that he must have known of one or more parasitized nests. Anderson (1907, p. 229) mentions this waterthrush as a victim in Iowa, where the breeding race is *notabilis*. Short (1896, p. 14) found that the race *noveboracensis* was parasitized in New York. In southern Quebec, three instances of cowbird parasitism out of 18 occupied nests which were examined were found by Terrill (1961, p. 8). Near Woodville, Ontario, Starr (1931, p. 154) discovered a nest with 3 eggs of the waterthrush and 1 of the cowbird; in Wayne County, Michigan, a nest with similar contents was found by Barrows (1897, p. 47).

Louisiana Waterthrush

Seiurus motacilla (Vieillot)

This species is parasitized rather frequently by the brown-headed cowbird, much more so than the northern waterthrush, but it cannot be ranked as one of the most used victims of the parasite. About 76 records, ranging from Ontario, New York, Connecticut, and Pennsylvania to West Virginia, Tennessee, Indiana, and Michigan, have come to my attention. The degree to which this bird is affected by the parasite appears to depend upon local conditions. In regions traversed by narrow wooded ravines and gorges, with open and unforested country between, this waterthrush often is victimized, whereas, in more consistently and extensively sylvan areas, it is less likely to be imposed upon. Cowbirds do not penetrate far into forests, and, as a result, seldom have occasion to make contact with this species in such areas.

At Ithaca, New York, I twice found fledgling cowbirds attended by these warblers; I was told by A. A. Allen that the great majority of all their nests which he had found in the past contained eggs or young of the cowbird. Similarly, Eaton (1914, p. 444), quoting Clarence Stone, wrote that "this warbler is much imposed upon by the cowbird whose visits annually cause disaster by its clumsiness in filling the nest with loose shale or dirt while kicking two to three of the . . . eggs out of the nest. In two instances I have noticed five eggs of the Louisiana water-thrush with two of the cowbird.

Several times nests were deserted where the cowbird had deposited her egg."

More than most of the regular hosts, this species is afflicted with multiple eggs of the cowbird. In my earlier summary (1929, p. 248), I noted that, of 55 parasitized nests, 25 held 1 cowbird egg each, 20 held 2, 7 held 3, and 3 held 4 eggs of the parasite. The ability of this waterthrush to rear a large brood of mixed offspring is revealed in a case listed by Wood (1951, p. 412): a nest found in Michigan by Walkinshaw contained three young warblers and two young cowbirds, all about ready to fledge.

Kentucky Warbler

Oporornis formosus (Wilson)

The Kentucky warbler is a locally common victim of the brown-headed cowbird (race *ater*). About 150 records have been noted, ranging from Delaware, Pennsylvania, Ohio, Indiana, Illinois, and Michigan to Iowa, Kansas, Oklahoma, and Kentucky. The greatest number of records are from Pennsylvania, a fact which may reflect a local difference in the incidence of parasitism but which also may be due to the presence in that state of two unusually successful and devoted egg collectors: J. Warren Jacobs (1893, 1938) and J. Parker Norris (1892a). Jacobs (1893) found cowbird eggs in no less than 47 nests of this warbler in Greene County, Pennsylvania. Many years ago Norris wrote me that he had in his collection 54 parasitized sets from Pennsylvania and Delaware. In Greene County, Jacobs (1893) estimated that about one-fifth of all the birds' nests which were found by him with cowbird eggs consisted of this species. He noted that of the 47 parasitized Kentucky warbler nests, 39 held 1 cowbird egg each, 7 held 2, and 1 held 3. These figures present a considerably different picture from that which we described for the Louisiana waterthrush.

In a later paper (1938), discussing his long span of observations near Waynesburg, Pennsylvania, J. W. Jacobs stated that he had examined several hundred nests of the Kentucky warbler over more than half a century. He kept records of 133 of these and found that 60 nests, or 45 percent, were parasitized by the brown-headed cowbird. Of 42 nests containing 5 warbler eggs each, 8, or 19 percent, held cowbird eggs; of 56 nests containing 4 warbler eggs each, 26, or 46 percent, held cowbird eggs; of 35 nests containing 3 warbler eggs each, 26, or 74 percent, contained cowbird eggs as well. In the 73 unparasitized nests, the preponderance of full clutches of 5 eggs brought the average up to 4.3 eggs per nest. The 60 parasitized nests showed an average of 3.8 warbler eggs per nest. In comparison to this, it should be noted that there were 0.25 cowbird eggs per nest;

or, to put it in other words, one out of every four pairs of Kentucky warblers seemed to have lost 1 egg from its normal clutch, In addition, some of the warbler eggs left in the nests were rendered losses because of shell punctures, which resembled claw or bill marks. Further, a fair number of nests were found deserted even before they were finished; other deserted nests may have contained 1 or 2 eggs, and some of these nests may have contained cowbird eggs, whose presence may have been related to their desertion. Jacobs concluded that, while the Kentucky warbler suffered heavily, the second broods were usually less heavily victimized by the cowbird than were the earlier ones.

Mourning Warbler

Oporornis philadelphia (Wilson)

The mourning warbler is a fairly frequent victim of the brown-headed cowbird in a few places, but generally it must be rated an uncommonly utilized host. Two parasite races are involved: *artemisiae* in an instance reported from Garland, Manitoba, by Godfrey (1953, p. 45); *ater* in 19 cases ranging from Quebec (Lloyd, 1949) and Ontario in Canada to New York, Michigan, Illinois (Pitelka, 1939), Wisconsin, and Minnesota (Chambers, 1947; Cox, 1958, 1960; Hickey et al., 1955) in the United States.

Near Montreal, Quebec, L. M. Terrill (1916, p. 8) reported that, of 25 nests of this warbler, 8, or 32 percent, contained eggs or young of the brown-headed cowbird. These figures indicate that, although the mourning warbler may be relatively unimportant in the economy of the parasite, the latter, in that area at least, may be a fairly serious factor in the numerical status of the former.

A record for the eastern race of the parasite by Black (1955, p. 23), who observed adult hosts feeding two of their own young and one young cowbird in Macomb County, Michigan, on June 26, is of interest because it shows that the presence of the parasite did not prevent the birds from rearing their own young along with it.

At Ithaca, New York, A. A. Allen found a recently fledged cowbird attended by a mourning warbler. Robbins (1947) reported two parasitized nests in Oconto County, Wisconsin, found in 1947 by Carl Richter.

Devitt (1944, p. 83) reported a nest with 2 eggs of the warbler and 1 of the cowbird at Minesing, Ontario, on June 9, 1929. Dr. Paul Harrington informed me that on that same date he found a parasitized nest near Wasaga Beach, South Georgian Bay, Ontario. Other cases are represented by parasitized sets of eggs in the R. M. Barnes collection, now in the Chicago Natural History Museum, and the J. H. Bowles collection, now dispersed.

MacGillivray's Warbler

Oporornis tolmiei (Townsend)

This warbler still is observed rather seldom; as a result, it is difficult to interpret the nine records of cowbird parasitism. Nine records would be very few for a well-known bird, but in the present species such a number is more significant. It appears, therefore, that MacGillivray's warbler should be looked upon as a regular, if not a very frequent, victim of the brown-headed cowbird.

Both of the currently recognized races of this warbler are known to be parasitized by the western race of the brown-headed cowbird, *M.a. artemisiae*. The nominate race of the warbler has been recorded as a host by S. J. Darcus from Penticton, British Columbia (Friedmann, 1934a, p. 104), and by Schultz (1958, p. 435) on the basis of an observation by Davidson at Victoria, British Columbia. Stephens (1932, p. 2) found the race *O.t. monticola* to be parasitized in Yosemite Valley, California, and French (1907, p. 156) found it thus in Colorado. A few additional cases for this race follow. LaFave (1955, p. 25) saw a fledgling cowbird attended and fed by a male MacGillivray's warbler near Wandermere, Washington, on July 29, 1954. King (1954) found a parasitized nest in Whitman County, Washington; still another Washington record is the basis for a statement by Jewett, Taylor, Shaw, and Aldrich (1953, p. 767). Rogers (1958, p. 430) made an observation similar to LaFave's at Baker, Oregon, on August 6. In the files of the U.S. Fish and Wildlife Service there is an observation by Edwin Willis of an adult MacGillivray's warbler attending a fledgling cowbird near Camp Connell, Calaveras County, California.

Yellowthroat

Geothlypis trichas (Linnaeus)

This wide-ranging species is one of the common victims of the brown-headed cowbird. Over 270 records have been noted from provinces of Canada—British Columbia, Alberta, Saskatchewan, Ontario, Quebec, New Brunswick—and the following of the United States: Arizona, Arkansas, California, Colorado, Connecticut, Delaware, Illinois, Indiana, Iowa, Kansas, Kentucky, Maine, Maryland, Massachusetts, Minnesota, Missouri, Montana, Nebraska, New Jersey, New York, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, Tennessee, Texas, Utah, Virginia, Washington, West Virginia, Wisconsin, and Wyoming. All 3 races of the cowbird are involved as are 10 races of the yellowthroat: *brachydactylus*, *trichas*, *ignota*, *campicola*, *occidentalis*, *inseperata*, *chryseola*, *arizela*, *sinuosa*, and *scirpicola*.

For some of the western races of the yellowthroat, the records are few in number, but this fact seems to be due more to a lack of observers

in some areas than to a real differential in the incidence of cowbird parasitism. In the case of the salt marsh race of San Francisco Bay, *sinuosa*, reported so far as a cowbird victim only by Grinnell and Wyeth (1927, p. 104), it is probable that the nature of this bird's habitat is not especially attractive to the cowbird; this is not the case with other sparsely reported victims such as *occidentalis*, *campicola*, and *chryseola*.

In my own field work at Ithaca, New York, I discovered five instances, and I was told of many others which had been observed in earlier years. In southern Quebec, Terrill found 113 nests in about 60 years of observations; of these, eight were parasitized—a much lower percentage of parasitism than occurs farther south. In Ohio, Hicks (1934) found that 19 out of 41 occupied nests were parasitized.

In spite of the fact that the yellowthroat long has been known as a frequent victim of the brown-headed cowbird, little in the way of an analysis of the host-parasite relationship has been available until recent studies by Stewart (1953) and especially Hofslund (1957), both conducted in Michigan. Stewart found that the average number of yellowthroat fledglings which were produced from a nonparasitized nest was 1.9, whereas in nests parasitized by the cowbird this average was only 0.1 (the average number of fledgling cowbirds produced per parasitized nest was 0.4). During a period of four years, Hofslund found 52 nests, 20 of which were parasitized. In these 52 nests, 152 yellowthroat eggs were known to be laid; of these 152 eggs, 52 were lost for various reasons. The loss of 30 of these 52 could be attributed to the cowbird: 10 eggs were removed by the parasite, 6 were punctured by it, 4 were lost because of nest desertion induced by cowbird activity, and there were 10 abortive eggs whose loss was due to lack of heat during incubation—the presence of larger cowbird eggs prevented close contact between the smaller eggs and the body of the incubating warbler. The percentage of egg loss attributed to the cowbird varied in the four years of the study from 16.6 to 88.8 percent of the total egg loss. The hatching success of the warbler was related to the number of cowbird eggs in a nest: "No more than two Cowbird eggs, or one Cowbird egg and two Yellow-throat eggs hatched in any nest; and if more than one Cowbird egg was present, no Yellow-throat eggs hatched."

Hofslund has attempted a quantitative analysis of hatching success in the yellowthroat. He started with Hann's estimate (1947, p. 174) that the probable limit of egg volume which a related warbler species, the ovenbird, can successfully incubate and hatch was between 1.3 and 1.8 times the volume of its normal clutch of 5 eggs and that

this limit was nearer to the lower than the higher figure. Applying Schönwetter's formula (1924) to average measurements for the yellowthroat and cowbird eggs, Hofslund calculated the average volume of a yellowthroat egg to be close to 1.7 cc. and that of a cowbird egg to be almost 3.1 cc. The volume of a normal 4-egg clutch of the yellowthroat would come to about 6.8 cc., which is little more than that of 2 cowbird eggs—6.2 cc. If 2 eggs of the yellowthroat were replaced by 2 of the cowbird, the resulting set would total 9.6 cc. or 1.4 times that of a normal 4-egg set of the host alone. While these figures are calculations and have not been tested in the field, Hofslund's observations indicate that 1.3 times the normal clutch volume "closely represents the limit of egg-volume that a Yellowthroat will normally hatch, and ordinarily one can say that a nest with more than one Cowbird egg in it is doomed to failure as far as the Yellow-throat eggs are concerned."

A surprising feature emerged from Hofslund's observations. Three-quarters of the parasitized nests contained more than a single cowbird egg; the average number in 20 parasitized nests was 2. Half of these eggs failed to develop to the fledgling stage; some were lost before hatching by nest desertion, predation, etc.; and some nestlings were lost to predation. The percent of cowbird eggs hatched was 42.5; of yellow-throat eggs, 65.8. Only 9 of the 20 parasitized nests produced cowbird fledglings—an average of 1.3 cowbirds per successful nest but only 0.6 cowbird per parasitized nest. It can be concluded that the cowbird is successful only moderately with the yellowthroat as a host, nevertheless, the former is an important check on the increase of the latter, with most of the damage to the host occurring during the egg stage.

The incidence of cowbird parasitism in several studies—reported in some detail—ranged from 7 percent to 46 percent of all the yellowthroat nests found. If we combine the totals of several surveys done in Michigan (Hofslund, 1957; Stewart, 1953; Batts, 1953; and Detroit Audubon Society, 1953–56) we find that, of a total of 90 observed nests, 35 nests, or 39 percent, were parasitized by the brown-headed cowbird.

Shaver (1918) studied the progress of a nest in which one young cowbird and two young yellowthroats were hatched. A summary of all the feedings indicated that the young parasite received 55 percent of the total amount of food. On the last day in the nest, the nestlings were visited by the adult warblers 348 times; the young cowbird received all, or part, of the food brought on 190 of these visits.

Occasionally, the yellowthroat may bury the cowbird eggs under a new nest lining. Weed and Dearborn (1903, pp. 162–163) record

a three-storied nest; each of the lower two stories contained a cowbird egg.

Since some of the western races of the yellowthroat are recorded only sparsely, it may be worthwhile to mention two instances that have not been referred to in my earlier lists. The race *campicola* has been recorded as a host of the western form of the brown-headed cowbird, *artemisiae*, in eastern Washington (Jewett, Taylor, Shaw, and Aldrich, 1953, p. 594). An additional record for the subspecies *occidentalis* comes to me from Mr. R. Kreuger, who has in his collection a set of 2 eggs of this race of the yellowthroat with 1 of the cowbird, collected at Canston, British Columbia, on June 6, 1948, by W. L. Maguire.

The northeastern subspecies, *G.t. brachydactylus*, is known to be a fairly frequent victim of the eastern race of the brown-headed cowbird. Aside from earlier records (when the host was listed as *G.t. trichas*), it should be noted that, in southern Quebec, 8 out of 113 nests, or 7 percent, which were found by L. M. Terrill (1961, p. 8) between 1897 and 1956, were parasitized.

Rio Grande Ground Chat

Chamaethlypis poliocephala (Baird)

There is a single record for this species (nominate race) as a host of the small race of the brown-headed cowbird. F. F. Nyc, Jr., collected a nest containing 2 eggs of the host and 2 of the parasite 7 miles southeast of Brownsville, Texas, on June 19, 1944. This set later was sent to A. J. B. Kirn for the collection of birds' eggs at St. Mary's University in San Antonio, Texas.

Yellow-breasted Chat

Icteria virens (Linnaeus)

The yellow-breasted chat is imposed upon frequently by the brown-headed cowbird, but the degree to which it is affected appears to vary very much locally. In some areas it is said to be one of the chief victims; in others it is molested only occasionally. About 180 records have been noted, ranging from Canada—Ontario, Saskatchewan (Potter, 1935), British Columbia—and the United States—Arkansas, Arizona, California, Connecticut, Delaware, Illinois, Indiana, Iowa, Kansas, Kentucky, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Montana, Nebraska, Nevada, New Jersey, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, South Dakota, Texas, Virginia, Washington, and Wisconsin—to northwestern Mexico in the state of Sonora, near Granados (A. Phillips, in litt.). There are numerous records for both races of the chat, *virens* and *auricollis*, and

for all three races of the cowbird. The nominate race of the chat is parasitized by *ater* and *artemisiae*; the race *auricollis* is victimized by *artemisiae* and *obscurus*.

The eggs of the chat are very similar in appearance to those of the cowbird; nevertheless, in many parts of its range, the chat is said to desert its nest if a parasitic egg is laid in it. This action is probably due to the shyness and nervousness of the bird rather than to any unusual acuity in distinguishing strange eggs from its own. (Many observers, particularly bird photographers, agree that the chat is one of the most timid of birds, and hence one of the most difficult to photograph at its nest.) Notwithstanding, on a fair number of occasions, chats have hatched and reared cowbirds. Nehrling (1896, p. 245) found such a case in southwestern Missouri. Smith (1921, pp. 175–177) found a chat's nest in Birdcraft Sanctuary, New York, containing 1 egg of its own and 1 of the cowbird. The next morning, there was a 2nd cowbird egg; the chat was flushed from the nest. Smith visited this nest every morning, but no more eggs were laid. After observing several day's incubation, he disturbed the nest and eggs in order to photograph them; even this did not seem to upset the chat. All 3 eggs hatched and all three of the nestlings grew up together and successfully fledged.

In Oklahoma, Nice (1931, p. 163) quoted Kirn to the effect that the chats there do not desert their nests when cowbird eggs are deposited in them. At Copan, of 22 nests found between 1910 and 1917, 13 contained from 1 to 3 cowbird eggs apiece, and 1 nest contained 4 chat eggs and 6 of the cowbird—a very crowded nest indeed.

In southern Michigan, Nickell (1955, pp. 89–90) found 11 nests, of which all but 1 were parasitized by the brown-headed cowbird. Five of these nests had a single cowbird egg apiece; two nests had 2 each; and the three remaining nests had 3, 4, and 5 of the parasitic eggs, respectively. Cowbirds hatched in five of these nests. Four of these five nests reared young to the fledging stage, as follows: first nest, two cowbirds and no chats; second nest, one cowbird and two chats; third nest, one cowbird and three chats; fourth nest, one cowbird and four chats. The fifth nest in which a cowbird hatched was destroyed by accident when the young parasite was five days old. Two of the other parasitized nests were not abandoned when first molested but failed to come through successfully. Only 3 nests out of the 10 that were parasitized were abandoned before incubation. Another case in which the young parasite and the young chat grew up together to the fledging stage was reported in North Carolina by Chamberlain (1959).

Here we have a body of evidence clearly at odds with data from elsewhere in the range of the host. No matter how satisfying it might be to have a mathematical evaluation of the host-parasite relationship, it is meaningless to consider adding these two bodies of evidence to produce an "average" behavioral response. Such an average would have no biological significance since it would reflect the picture in no one individual. The only justifiable approach is to admit that there is a surprising variability of response on the part of the chat and that, in terms of present data, this variability appears to be local. Whether this evidence should be taken to imply, or even to suggest, the existence of parasite-tolerant and parasite-intolerant "strains" within the species cannot be debated without more detailed data from many parts of its range; such data should include the inheritance, if any, of parasite-tolerance in the area where it is known to occur.

In 1924 in the lower Rio Grande Valley of Texas, I found the western race of the chat to be a common host of the dwarf race of the cowbird. Of four nests which were found, all were parasitized. Hanna (1928, p. 161) recorded five parasitized nests in southern California. E. M. Tait informed me many years ago that he found three nests with cowbird eggs (*artemisiae*) at Trout Creek Point, British Columbia. Mr. Guy Love wrote to me of a similar nest which was found on June 22, 1908, in Decatur County, Kansas. The instance involved the eastern race of the parasite and the western race of the host—the first time this particular subspecific combination has been found.

Hooded Warbler

Wilsonia citrina (Boddaert)

Although the number of definite instances of parasitism has increased in recent years, the hooded warbler may be described as a somewhat uncommonly recorded victim of the brown-headed cowbird. Thirty-two cases have been noted, distributed among the following states: Connecticut, New York, New Jersey, Pennsylvania, Maryland, Virginia, Georgia, Alabama, Indiana, Illinois, and Michigan. Stewart and Robbins (1958, p. 329) mention five cases in Maryland. Five, possibly six, occurrences have been reported from one locality, Lake Orion, in Michigan: Middleton (1952, p. 7) gave four records; Wallace and Black (1949, p. 15) found a hooded warbler feeding two of its own and one cowbird fledgling; and Wickstrom (1951, p. 114) noted a record of a parasitized nest which may be among the four listed by Middleton. On the basis of these and other recent records, it seems that increasing data may make it necessary to reconsider the status of the hooded warbler with respect to the cowbird. The best that may be said at present is that, while this warbler is not a frequently imposed upon species, it cannot be called a very uncom-

mon host. Several records from Georgia (Chamberlain and Denton, 1949; Parkes, 1950; Chamberlain, 1958; Webb and Wetherbee, 1960) reveal that in this southeastern area, which recently has been invaded by the parasite, the hooded warbler seems to be a rather frequently chosen host.

Wilson's Warbler

Wilsonia pusilla (Wilson)

Wilson's warbler has been reported very seldom as a cowbird victim, but locally it is probably a fairly common host. Fourteen records have been noted, all but two from southern California (race *chryseola*): one from eastern California and the other from Alberta (race *pusilla*). Most of the California records involve the small race of the cowbird, *M.a. obscurus;* two from Mono County (Dixon, 1934, p. 36; Rowley, 1939, p. 251) and the record from Alberta refer to *M.a. artemisiae.*

In southern California, Willet (1912, p. 70) recorded three parasitized nests in Ventura County; LaJeunesse (1923, pp. 31–32) found five nests in Alameda County, each of which contained eggs of the cowbird. The last five nests were all found within one month in a limited area, a fact which indicates that there the cowbird was making much use of the nests of this warbler. M. C. Badger wrote me that the bird is a very common victim in southern California. Unglish (1931, p. 214) found a parasitized nest in San Benito County; Peyton (1931, p. 162) found another in Ventura County. Other records in private egg collections, transmitted to me without definite localities, are three in number. Talmadge (1948) recorded a cowbird egg from the nest of either *Wilsonia pusilla* or *Vermivora celata* at Fernbridge, Humboldt County, California. Although this record is uncertain, it probably involves *Wilsonia.*

The one Alberta record was found by T. E. Randall at Boyle, Alberta, on May 27, 1934—a nest with 4 eggs of the warbler and 1 of the cowbird.

Canada Warbler

Wilsonia canadensis (Linnaeus)

The Canada warbler is a regular but infrequent host of the brown-headed cowbird. It has been known to be imposed upon by the nominate race of the parasite in Ontario, New Brunswick, New York, Indiana, Michigan, and Minnesota. Recently, it has been found by Street (Houston and Street, 1959, p. 176) to be molested by the western race, *artemisiae,* at Nipawin, Saskatchewan. Instances of this warbler as a victim of the eastern brown-headed cowbird may be noted as follows. C. T. Black (1955, p. 23) listed three cases in Lapeer and Macomb Counties, Michigan, and Nolan (1958, p. 417) added another one from Dunes Park, Indiana. Besides these, there

are three cases from Ontario and one each from New York and Minnesota. The Canada warbler has been known to hatch and rear cowbirds: Roberts (1932, p. 277) noted a nest with young of the parasite in Minnesota.

Redstart

Setophaga ruticilla (Linnaeus)

The redstart is one of the commonest victims of the brown-headed cowbird, but, probably because it is parasitized so frequently, many observers have felt it unnecessary to record their data. The result is that the total published material is much less than that which exists for a number of species less often imposed upon by the parasite. In my own field work in central New York, I found cowbird eggs or young in 23 out of 34 nests examined; I have not found a similarly high incidence of cowbird parasitism reported from any other area. In Ohio, Hicks (1934) discovered 22 nests, of which 7 were parasitized; and in southern Quebec, Terrill (1961, p. 8) found 145 nests, of which 23 held cowbird eggs. All in all, about 200 records have been noted, ranging from Saskatchewan, Ontario, Quebec, and New Brunswick to Idaho, Minnesota, Iowa, Wisconsin, Michigan, Ohio, Maine, Massachusetts, Connecticut, New York, Pennsylvania, New Jersey, Delaware, Maryland, Virginia, Alabama, Arkansas, and Oklahoma.

The incidence of cowbird parasitism noted in several studies, which have been reported on in some detail, varied from less than 2 percent to 10, 33, 42, and even as much as 70 percent of all the redstart nests found.

The records include both races of the redstart, *ruticilla* and *tricolora*, and two races of the cowbird, *ater* and *artemisiae*. Both of these races of the parasite molest *tricolora*, while only *ater* has been observed in relation to *ruticilla*; in fact, only recently have the following two records, involving the northwestern cowbird *artemisiae*, been reported. Street (*in* Houston and Street, 1959, p. 166) found a nest of *tricolora* at Nipawin, Saskatchewan, containing only a nestling cowbird. Burleigh (1952) observed a recently fledged cowbird being fed by redstarts at Missoula, Montana.

Occasionally, the redstart may build a new lining or floor over a cowbird egg, if, as sometimes happens, the cowbird deposits her egg before the host female deposits hers. The redstart is usually a very tolerant host, accepting the strange eggs and rearing the young. At times, however, although the redstarts assume charge of the cowbird eggs, they may show an initial hostility toward the female cowbird prior to actual ovulation. Strum (1915, pp. 202–203), noting that both adult redstarts reacted aggressively toward female cowbirds, concluded that this show of hostility saved them from excessive para-

sitism. He implied that this form of behavior might explain the fact that, out of 18 nests found, only 1 was parasitized. Terrill noted that the redstart seldom tolerates the cowbird's parasitism in cases wherein the latter lays first. Nine such nests which were known to him were deserted.

House Sparrow

Passer domesticus (Linnaeus)

This widespread, introduced species is molested very seldom by the brown-headed cowbird. The fact that the sparrow is so much a town and city bird has something to do with the phenomenon, but this, itself, in is not enough to account for the relative immunity of *P. domesticus* to parasitism. The following are the only records which have been noted. In the Hudson highlands of New York, Mearns (1878, p. 23) found that a cowbird egg had been hatched by house sparrows in Highland Falls; moreover, the young cowbird flourished and remained with the sparrows for some time. Davie (1889) listed the house sparrow as a cowbird host—possibly on the basis of the above statement. R. B. Rockwell (1909, p. 92) found a partially incubated cowbird egg in a house sparrow's nest at Barr, Colorado. Linsdale (1937, p. 177) noted, also at Barr, that a pair of house sparrows took over a magpie's nest after the original owners had left and started to build their own nest in it; afterwards, he found a cowbird's egg in the nest. Burleigh (1923, pp. 90–91) found a cowbird's egg in a house sparrow's nest inside a bird nestingbox in Alleghany County, Pennsylvania. Williams (1950, p. 153) listed the house sparrow as a cowbird victim in the Cleveland, Ohio, area. Ellis (1924, p. 208) noted it as fosterer in southern California. Imhoff (in litt.) saw a house sparrow feeding a fledged cowbird at Bethesda, Maryland, on July 19, 1960. Leathers (1956, p. 68) reported that near his home at New Castle, Pennsylvania, there were in use every year a half dozen house sparrow nests which the cowbirds parasitized regularly. Stamm (1961) made a similar observation in eastern Kentucky.

The Colorado data involve the race *M.a. artemisae* of the cowbird; the Ohio, New York, Pennsylvania, Maryland, and Kentucky records refer to typical *M.a. ater;* the southern California record refers to *M.a. obscurus.*

Bobolink

Dolichonyx oryzivorus (Linnaeus)

The bobolink is an infrequently used host, but, in Iowa, Gabrielson (1914, p. 79) considered it to be one of the commonest victims of the parasite (although he actually recorded only a single instance of cowbird parasitism on this species). Some 22 records have been noted in all, distributed among the following states: Connecticut, New York, Ohio, Michigan, Wisconsin, Iowa, Minnesota, and Montana. When

we remember what a small percentage of bobolink nests are ever found—secreted as they are in grassy meadows and invisible from above because of their semi-domed structure—it may not seem surprising that relatively few records are available. However, it does not follow that the observed incidence of parasitism would be affected by this rather meager sampling.

Silloway (1917, p. 45, p. 158) found a nest in Judith Basin County, Montana, with 3 eggs of the bobolink and 2 of the cowbird. In this case, the cowbird was the race *artemisiae*. All the other records known to me involve the eastern race *ater*.

In Ohio, Hicks (1934) found the surprising total of 184 nests of the bobolink; of these, 10, or a little over five percent, were parasitized. Roberts (1932, p. 288) lists only one Minnesota record—a nest with 3 eggs of the host and 3 of the parasite.

Eastern Meadowlark

Sturnella magna (Linnaeus)

The eastern meadowlark is an uncommon host of the brown-headed cowbird. Bendire (1895, p. 460) noted that "this bird is occasionally imposed upon . . . and an instance has been recorded where a second nest was built over the one containing the parasitic egg." Gross (*in* Bent, 1958, p. 74) concluded that, in most sections of its range, the meadowlark seems to escape the attentions of the cowbird. He noted that G. B. Saunders, who studied some 50 nests in New York and Oklahoma, never found a cowbird's egg in any of them; neither did Bent with his varied nest-hunting experience. In southern Quebec, Terrill (1961, p. 8) examined 52 nests, only 1 of which was parasitized. Yet, in Illinois, Gross found four parasitized nests and Eifrig (1915, p. 418; 1919, p. 520) repeatedly found similar instances in the Chicago area "with one or more eggs of the cowbird, and one or more or all the eggs of the rightful owner apparently rolled out. An example of this was found June 24, 1917, with two cowbird eggs inside and four meadowlark eggs outside . . . ." Apparently, the meadowlark is parasitized more frequently in northern Illinois than in many other areas. In Nebraska, Hergenreder (1962) found 31 nests, of which 5 had been parasitized. In Wisconsin Lanyon (1957, p. 43) reported that, of 38 nests observed, 6 (16%) contained cowbird eggs. One of these nests was deserted when the parasite made a hole in 1 out of the full clutch of 5 meadowlark eggs.

The fact that the hosts' eggs so often are found outside the nest is puzzling and deserves study. It is probable that the large egg of the meadowlark is too big for the parasite to carry off, and the egg therefore may be left on the ground not far from the nest. No mention was made as to whether or not these expelled eggs were damaged;

if they were removed by the cowbirds, one might expect them to show bill or claw holes.

All in all, some 32 records have been noted, distributed in Ontario, Quebec, Massachusetts, Connecticut, New York, New Jersey, Pennsylvania, Ohio, Indiana, Illinois, Michigan, Wisconsin, Minnesota, Iowa, Nebraska, Kansas, Oklahoma, Arkansas, and Texas. These records involve three races of the meadowlark: *argutula* in Arkansas, *hoopesi* in Cameron County, Texas, and *magna* in all the other records. The cowbird involved in the Texas record is the race *obscurus;* in all the other records, it is the typical race, *ater*.

I know of no instance wherein a meadowlark has hatched and reared a young cowbird. As far as the parasite is concerned, this is not a successful host.

Western Meadowlark

Sturnella neglecta Audubon

This species appears to be very similar to the eastern meadowlark in its relations with the brown-headed cowbird. Occuring as it does in areas under less observation, the western meadowlark has been noted as a cowbird host even less often than its eastern counterpart. Twenty-four records have come to my attention from British Columbia, Alberta, Saskatchewan, Idaho, Montana, Colorado, Kansas, Nebraska, North Dakota, Minnesota, and Wisconsin. All the records involve the typical race of the western meadowlark, *neglecta:* the Nebraska record, anonymously published without definite locality (1934, p. 69), involves the eastern race of the cowbird, *ater*, as do the Wisconsin records, while the remainder are of the northwestern race, *artemisiae*.

Silloway (1917, p. 45) found a nest with no fewer than 5 eggs of the cowbird and 2 of the host in Judith Basin County, Montana. He wrote that this was the first time he had ever found the parasite's eggs in a nest of this bird but that later he discovered that the cowbird "frequently imposes upon the meadowlark in the northwest." These implied records from the northwest have not appeared in print. In the files of the U.S. Fish and Wildlife Service there is the record of a parasitized nest found in Dickey and the Thousand Springs Valley, Idaho, in June 1912, by L. D. Wyman. Mr. T. E. Randall found another such nest in Alberta, and there is a Saskatchewan record in the Provincial Museum at Regina. Lanyon (1957, p. 43) found 41 nests with complete clutches in the course of his work in Wisconsin. Of these, 9, or 22%, contained eggs of the cowbird.

Yellow-headed Blackbird

Xanthocephalus xanthocephalus (Bonaparte)

The yellow-headed blackbird has been reported only occasionally as a victim of the brown-headed cowbird. I have found 11 records,

distributed from Illinois, Minnesota, Montana, and "northwestern Canada" to Wyoming, Colorado, and California. T. S. Roberts (1909) reported three parasitized nests in one breeding colony of yellow-heads. Lincoln (1920, p. 69) wrote that, in the Clear Creek district of Colorado, this blackbird was one of the most imposed upon local hosts. These observations suggest that the yellow-headed blackbird locally may be a not uncommon victim; but over the extensive range of its sympatry with the cowbird it is not known to be affected to any degree.

As many as 6 eggs of the parasite along with 4 of the owner have been reported in a single nest at Laramie, Wyoming, by Henninger (1915, p. 232).

All three races of the parasite are involved in the known records: *ater* in those from Illinois, Michigan, and Minnesota; *artemisiae* in those from Montana, Wyoming, Colorado, and northwestern Canada; and *obscurus* in one case from Los Banos, California. H. R. Eschenberg informed me that there he found a nest on May 6, 1936, containing a dwarf cowbird's egg in addition to 4 eggs of the blackbird.

Redwinged Blackbird
Agelaius phoeniceus (Linnaeus)

The redwinged blackbird is a fairly common victim of the brown-headed cowbird in some areas, but it is almost unmolested by the parasite in other localities. In regions where the redwings are largely colonial nesters in cattail swamps, they are rarely bothered by the cowbird; where their nests are more scattered and in bushes, they often are parasitized.

In Michigan, Nickell (1955, p. 91) examined 1300 active nests of this blackbird over a period of 15 years and found the frequency of known parasitism to be about 1 in every 185 nests. All the parasitized nests were either solitary or at the perimeters of colonies—a hundred feet or more from their nearest conspecific neighbors. He concluded that, because of the combined aggressiveness and vigilance of the blackbirds, few cowbird eggs are deposited in redwing nests that are in definite colonies. Nickell also concluded that any cowbird which was hatched in a nest with two or more redwings would have slight survival chances because of the larger size and aggressiveness of the host's own nestlings. Nickell's observations are in agreement with those first made by Sutton (1928) in the Pymatuning Swamp in western Pennsylvania; these data demonstrated the tendency of the redwings to drive away any intruding cowbirds, thereby protecting not only their own nests, but also—though not intentionally—those of vireos and warblers breeding close by. Trautman's experience at Buckeye Lake, Ohio, as summarized

by Bent (1958, p. 144), establishes further corroboration. Out of hundreds of redwing nests found by Trautman, only four were parasitized and these were isolated nests, considerably removed from the main colony. Trautman rightly concluded that it was possible for a cowbird to lay in a solitary nest without discovery and inevitable pursuit, but not in a colony. In Minnesota, Roberts (1932, p. 303) noted that those redwing nests which were built in the marshes usually were not parasitized, whereas those in bushes on uplands near the marshes generally contained cowbird eggs. Although Roberts does not say so specifically, it appears that the nests built in upland bushes were scattered more widely than those in the cattail swamps. In Kent Island, Maryland, during two successive seasons (1958–59), Meanley (in litt.) examined 367 nests and found that five were parasitized. He later wrote me that in his experience, in Maryland and elsewhere, such parasitism invariably occurred in the very earliest redwing nests. The redwings begin nesting earlier than most of the other passerine birds and the cowbirds begin to lay about the same time as the redwings, but the parasites do not seem to bother the latter when other potential hosts become available.

At Ithaca, New York, a region where both the redwing and the cowbird are very common and where both species have been exhaustively studied (A. A. Allen, 1913b; Friedmann, 1929), many hundreds of nests of the redwing have been examined but none have been found to be parasitized. That some variation may occur, even in such areas, is suggested by the observations of Goelitz (1916, p. 147) in Illinois, who writes that, "until this year I have never found eggs of this bird [cowbird] in redwing's nests, but in a little colony of some twenty-five pairs of red-winged blackbirds I destroyed eleven cowbird eggs on June 17, and six on June 27 of the present season."

Smith (1943, p. 198) studied these blackbirds near Chicago and found that cowbirds seldom molested redwings nesting in sizeable colonies. In 1940 at Orlando, the incidence of parasitism was only 0.6 percent (a single case, in which 2 cowbird eggs were laid in an empty redwing nest, resulting in its desertion.) In 1941, no cowbird eggs were found among 563 eggs of redwings. Smith suggested that "there may be an aggregate effect of numbers which retards or even prohibits the deposition of cowbird eggs in redwing populations of high density. In view of the restricted incidence of cowbird parasitism and its apparent negligible effect upon redwing mortality, it would appear that this factor is of little importance in a consideration of the success of redwing reproduction."

In further studies in Arkansas as well as in Illinois, the same author (1949, p. 60) found that, out of 653 nests of the redwing, 14 were parasitized, 13 with 1 cowbird egg in each, and 1 with 2 cowbird

eggs. During the four years of his study, 1,981 redwing eggs were laid in the 653 nests with these 15 cowbird eggs. These data show an expected distribution of 2.1 percent of nest parasitism and an incidence of parasitism of 0.8 percent per redwing egg. Of the cowbird eggs, 14, or 93.3 percent, failed to hatch. Six of them were doomed by the situation in which they were laid: 3 in abandoned nests, 2 deposited at least six days after the incubation of the hosts' eggs had begun, and 1 laid on cattail stalks just below a nest. The limited distribution of parasitized nests and the very low survival success of the cowbird eggs indicate that the redwinged blackbird is not a favorable host species.

In Decatur County, Kansas, L. R. Wolfe (in litt.) found that the redwings very frequently were parasitized. He wrote me that "probably 90 percent of the redwing nests contained one or more eggs of the cowbird, and I remember frequent extended searches to find a nest without eggs of the parasite. During the years 1909 to 1914 I probably collected twenty or more sets of the thick-billed redwing with cowbird eggs." The incidence of cowbird parasitism in Decatur County as summarized by Wolfe is much higher than has been reported in any other area. From Nebraska have come more than 30 records, a fact which suggests a high incidence there as well. In Colorado, Lincoln (1920, p. 69) considered the redwing one of the species most frequently parasitized, but he gave no quantitative data. It appears that at Brenham, Texas, the Gulf Coast race of the redwing, *littoralis*, frequently is victimized by the dwarf race of the cowbird. Nyc (1936, p. 87) refers to the eggs of this redwing as consisting of the "usual sets of three plus a dwarf cowbird egg or two."

About 180 records have been noted, distributed among provinces of Canada—Alberta, British Columbia, Manitoba, Ontario, Quebec, Saskatchewan—and the following of the United States: Arizona, Arkansas, California, Colorado, Connecticut, Illinois, Indiana, Iowa, Kansas, Maryland, Michigan, Minnesota, Missouri, Montana, Nebraska, New Jersey, North Dakota, Ohio, Oklahoma, Pennsylvania, Rhode Island, Texas, Utah, Washington, Wisconsin, and Wyoming. All three races of the cowbird are involved, and nine races of the redwing: *phoeniceus*, *littoralis*, *megapotamus*, *arctolegus*, *fortis*, *nevadensis*, *californicus*, *neutralis*, and *sonoriensis*. The racial combinations so far recorded are as follows: *M.a. ater* has been found to parasitize *phoeniceus*, *littoralis*, *megapotamus*, *arctolegus*, and *fortis*; *M.a. artemisiae* is parasitic on *arctolegus*, *fortis*, *nevadensis*, and *californicus*; *M.a. obscurus* victimizes *megapotamus*, *californicus*, *neutralis*, *littoralis* and *sonoriensis*. If the proposed race *utahensis* should be accepted officially, to it would have to be referred a record of cowbird parasitism published by Bee and Hutchings (1942, p. 82).

There are at least two records of a redwing hatching and rearing a cowbird: an instance told to me years ago by the late Waldron de Witt Miller, occuring in New Jersey, and a case reported by Blocher (1924). In the latter instance, the nest contained three young redwings and one cowbird when first found, but only the parasite survived.

In Nebraska, Wolcott (1899, p. 18) noted the two-storied nest of a redwing, in the lower part of which a cowbird's egg was buried. He wrote that, in his experience, the redwings, when parasitized after they already have laid some eggs themselves, "apparently peck holes in all, including that of the intruder, and desert the nest." Such behavior would be most interesting, but there is no way to rule out the possibility that the holes were not the work of marsh wrens or other creatures coming upon a deserted nest.

Orchard Oriole

Icterus spurius (Linnaeus)

The orchard oriole is a fairly frequent host of the brown-headed cowbird, but the actual records noted are few in number—only 18 in all. Supplementing the actual instances there are statements such as one made by Bendire (1895, p. 481) to the effect that, in the northern parts of its range, the orchard oriole is "more or less imposed upon by the cowbird . . ." and the statement made by R. W. Quillin (in litt.) that around San Antonio, Texas, this oriole very frequently is parasitized. The actual cases have come from Ontario (Essex and Kent Counties), Rhode Island, Connecticut, New Jersey, Maryland, Ohio, Indiana, Michigan, Iowa, Kansas, Missouri, Tennessee, Oklahoma, and Texas. Two races of the parasite, *ater* and *obscurus*, are involved. Although he does not mention any specific records of parasitism in New Mexico, Ligon (1961, p. 262) writes that the scarcity of the orchard oriole in that state may be due partly to the fact that it suffers from the attentions of the cowbird.

Black-headed Oriole

Icterus graduacauda Lesson

There is a single record of this oriole, race *audubonii*, as a host of the southwestern race, *obscurus*, of the brown-headed cowbird. Near Brownsville, Texas, in May, 1924, I found a nest of this oriole containing 1 egg of the dwarf cowbird, 1 of the red-eyed cowbird, *Tangavius aeneus*, and none of the oriole. When found, the nest had been deserted.

Hooded Oriole

Icterus cucullatus Swainson

The hooded oriole has been recorded a few times as a victim of the dwarf race, *obscurus*, of the brown-headed cowbird in California,

Arizona, and Texas. The records from Texas refer to the eastern race of the oriole, *sennetti*; the Arizona and California instances relate to the race *nelsoni*.

Scott (1885, p. 163) recorded a parasitized nest in Arizona; Bendire (1895, p. 475) wrote that the eastern race was imposed upon considerably by both the dwarf cowbird and the red-eyed cowbird and that occasionally one nest held eggs of both species of parasites. Near Brownsville, Texas, in May, 1924, I (1925, p. 550) found 16 nests of the hooded oriole, one of which was parasitized by the dwarf race of the cowbird. Two additional parasitized sets of eggs from Brownsville, Texas, taken in 1928, are now in the collections of the Carnegie Museum. In the C. E. Doe collection in the Florida State Museum there is a parasitized set of eggs taken in Hidalgo County, Texas, on May 22, 1878.

Abbott (1933, pp. 124–125) found a nest with 4 eggs of the oriole and 2 of the cowbird on June 8 in California (locality not given). Rowley (1930, pp. 130–131), in southern California, late in the afternoon of a day in May, saw a female hooded oriole leave her nest. A few minutes later, a female brown-headed cowbird flew to the nest and entered it. The cowbird remained in the nest not more than two or three minutes, during which time she laid her egg and either kicked out or removed with her bill one of the oriole's eggs. Rowley found the oriole egg on the ground where it had been dropped. A similar observation was made by Allanson (in litt., to J. T. Zimmer).

Ellis (1924, p. 208) and Bennett (1943, p. 240) report that hooded orioles were seen feeding recently fledged cowbirds in southern California—evidence that this host can and does rear the young parasite beyond the nestling stage. Two nests of the hooded oriole, collected in 1917 at Tucson, Arizona, and now in the collection of the Santa Barbara Museum of Natural History, each contained 1 egg of the dwarf race of the brown-headed cowbird, 1 of the bronzed cowbird, and 2 of the oriole. Another parasitized set, collected at Tucson, by J. W. Lytle, on June 2, 1897, is now in the Museum of Natural History at the University of Minnesota.

Baltimore Oriole

Icterus galbula (Linnaeus)

This oriole is parasitized very infrequently by the brown-headed cowbird; only 13 actual cases have been noted and no observer has written that this bird is a common victim anywhere in its range. The records involve two races of the parasite: *artemisiae* in Alberta and Saskatchewan; *ater* in New York, Pennsylvania, Indiana, Michigan, Minnesota, Wisconsin, and Iowa.

Warren (1890, pp. 209–210), in Pennsylvania, on three occasions

found broken cowbird egg shells directly beneath the pendant nests of Baltimore orioles and asked whether orioles occasionally throw out the parasitic eggs. No one yet has produced any evidence on this point. If it were found that these birds do eject the strange eggs, this factor might play a role in the apparent paucity of records of cowbird parasitism.

Gregg (1891, p. 26) found a nest in Chemung County, New York, containing a nearly fledged cowbird "big enough to fly" and two orioles much less advanced in development. Nauman (1930) watched the development of a young cowbird which was reared in the nest of a Baltimore oriole in Iowa.

The northwestern records involve *M.a. artemisiae*. T. E. Randall wrote me many years ago that he had found a parasitized nest in Alberta; Street (Houston and Street, 1959, p. 176) found another at Nipawin, Saskatchewan.

The Baltimore oriole may at times cover over a cowbird egg with a new nest floor. Parshall (1884) discovered a deserted nest containing 3 eggs of the oriole and 3 of the cowbird plus 3 more eggs of the parasite imbedded under a new nest lining.

Bullock's Oriole

Icterus bullockii (Swainson)

Bullock's oriole is a rarely parasitized bird. I have learned of very few records, all of which are mentioned here. This species was listed by Bendire (1895, pp. 442, 448) as a host of two races of the cowbird, *ater* and *obscurus*. He wrote that "Bullock's Oriole may occasionally rid herself of the parasitic egg; at any rate I noticed the remains of one lying under a nest of this species, with portions of one of her own. The nest contained only three eggs of the rightful owner and the bird was sitting on these." He found it occasionally parasitized in Arizona but he did not list specific instances. In Oklahoma, R. C. Tate found a nest of Bullock's oriole on July 12, 1911, with one young oriole and two young cowbirds; two dead young orioles were on the ground beneath the nest (Nice, in litt.; also 1931, p. 169). A parasitized set of eggs was taken in Baylor County, Texas, May 14, 1952, by T. C. Meitzen (in litt.). Mr. Griffing Bancroft wrote me years ago that he had collected a set of 5 eggs of this oriole with 1 of the dwarf cowbird in Imperial County, California, on May 18, 1921. Another parasitized nest, also found in Imperial County, on May 18, 1919, is now in the collections of the Western Foundation of Vertebrate Zoology. Linsdale (1949, p. 251) found Bullock's oriole feeding a recently fledged cowbird at Robles del Rio, California. The California records involve the race *parvus* of the host; the Arizona, Texas, and Oklahoma records, typical *bullockii*.

Rusty Blackbird

Euphagus carolinus (Müller)

The rusty blackbird has been recorded as a host of the northwestern race of the brown-headed cowbird, *M.a. artemisiae*, in Alberta. T. E. Randall informed me many years ago that he had found two parasitized nests of this blackbird; A. D. Henderson also wrote me of similar observations.

In a commercial price list of November, 1947, the natural history dealer, C. H. Gowland of Wirral, England, listed two sets of eggs of the rusty blackbird, each with eggs of the cowbird. No locality or date was given for either set, and correspondence failed to obtain either the specimens or further data about them.

The Alberta records refer to the typical race of the host. Because the parasite does not breed in the range of the Newfoundland race *nigrans*, the Gowland sets presumably also involve the nominate race of the host.

Brewer's Blackbird

Euphagus cyanocephalus (Wagler)

Brewer's blackbird frequently is imposed upon by the brown-headed cowbird in Alberta and Montana, and it also has been noted as a cowbird host in British Columbia, Saskatchewan, Colorado, Minnesota, and California. In the Rowan collection at the University of Alberta there are seven parasitized sets of eggs which were taken in Alberta. Other Alberta records have come to my attention from T. E. Randall and A. D. Henderson.

In Gallatin County, Montana, A. A. Saunders (1911, p. 40) found cowbird eggs more often in nests of Brewer's blackbird than in nests of any other species; he wrote that a large percentage of the blackbird nests were parasitized. Cameron (1907, pp. 396–397) found the bird parasitized in Custer and Dawson Counties, Montana, and Rust (1917, p. 37) found a parasitized nest in Fremont County, Idaho. At St. Vincent, Minnesota, Peabody (1909b, pp. 15–20) concluded that few nests of this blackbird seemed to escape the visitation of the cowbird. More recent observers (Hayward, 1950; Mierow, 1949; Warner, 1951) also have reported this blackbird as a regular host of the cowbird in Minnesota. Betts (1912, p. 204) found it imposed upon in Boulder County, Colorado. Mrs. K. Paton has informed me of at least three parasitized nests at Oxbow, Saskatchewan.

As many as 3 cowbird eggs have been found in one nest of this blackbird; in fact, 4 eggs of the parasite have been found in a single nest together with 7 of the owner—a crowded nest indeed.

All the records, with the exception of one from California, refer to the northwestern race of the cowbird, *M.a. artemisiae*. The southwestern race, *obscurus*, is involved in the record of a parasitized nest

found at Gustine, California, on June 6, 1932, by H. R. Eschenberg (Friedmann, 1943, p. 355).

Common Grackle

Quiscalus quiscula (Linnaeus)

This species is a rarely victimized bird; only six instances have come to my attention. Because the grackle is much larger than the cowbird and also very aggressive—well able to drive off an intruder—it is not surprising that the bird rarely is molested. All the records refer to the race *versicolor* of the grackle. One record, from North Dakota, refers to the race *artemisiae* of the parasite; the others, to typical *ater*. The North Dakota instance was found by Alfred Eastgate, who wrote to me about it without giving an exact locality or date. There is one record from Texas, where Strecker (1927, p. 47) found a parasitized nest in McLennan County. In Illinois, Strumberg (1879, p. 79) reported a nest at Galesburg, with 5 eggs of the grackle and 1 of the cowbird. Barnes (1918, p. 109) found a nest with 4 eggs of the victim and 2 of the parasite; he wrote to me that he had in his collection two parasitized sets of grackle eggs, both collected "May 10, 1896, a little over one mile from this place (Lacon, Illinois) in the overflow bottoms of the Illinois River, both nests in willow trees, one only eighteen inches above the water and the other four feet up. Each of the nests contained one Cowbird [egg] and all of the eggs were fresh, the nests were less than a hundred feet apart; never before or since have I found Cowbird's eggs in the nest of this species." In the collections of the California Academy of Sciences there is a cowbird egg taken from a grackle's nest near Winchester, Illinois, on April 26, 1889, by W. C. Hutchinson.

It should be pointed out that Bent (1958, p. 415) referred to a record of cowbird parasitism on the grackle in Iowa. This may be based on Keyes and Williams (1888, pp. 24–25), who made a statement which suggests, without actually giving explicit data, that the common grackle is parasitized in Iowa. What they wrote is that, early in the season before the smaller species of birds have begun to nest, the cowbird is forced to lay in the nests of larger species—among which they list the bronzed grackle.

Western Tanager

Piranga ludoviciana (Wilson)

The western tanager has been reported as a victim of the brown-headed cowbird only three times to my knowledge. E. M. Tait wrote me that he found two parasitized nests at Trout Creek Point, British Columbia. One contained young of both the victim and the parasite; the other held eggs of both species. A. D. Henderson informed me

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that he had found this tanager to be victimized in Alberta; and recently, Rogers (1956, p. 399) has reported it as a victim at Melita Island, Montana. In all these cases the cowbird involved is the race *artemisiae*.

Scarlet Tanager

Piranga olivacea (Gmelin)

The scarlet tanager is the most commonly parasitized species of its family, but it is not among the chief hosts of the brown-headed cowbird. About 50 records have been noted, distributed among the following states: Connecticut, Illinois, Indiana, Iowa, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Nebraska, New York, New Jersey, Ohio, Pennsylvania, West Virginia, and Wisconsin; and Ontario, in Canada (3 records).

J. P. Norris (1892b, pp. 21–22) stated that, of 22 sets of eggs of this tanager in his collection, 7 contained 1 or more cowbird eggs. All seven of the parasitized sets were collected at Nazareth, Pennsylvania, during two successive summers, 1887 and 1888. Since a fair percentage of the nests were parasitized, it would appear that in this locality the scarlet tanager was a frequent host. In Iowa, Keyes and Williams (1888, p. 34) found the scarlet tanager to be parasitized so heavily that they wrote that the nests of this species "almost invariably" contained from 1 to 3 eggs of the parasite. Mulliken (1899, p. 18) noted a nest containing the surprising total of 9 eggs, 5 of which were cowbird, and, judging from the variation in color and pattern, these 5 seemed to have been laid by five different individuals. Hess (1910, p. 26) reported a scarlet tanager incubating 4 cowbird eggs with 1 of its own. At Ithaca, New York, I saw a recently fledged cowbird being fed by a female scarlet tanager. Statements to the effect that this tanager may occasionally desert its nest if a cowbird lays in it have been made loosely without supporting evidence.

All the records refer to the eastern race of the cowbird, *ater*.

Summer Tanager

Piranga rubra (Linnaeus)

The summer tanager is an uncommon victim of the brown-headed cowbird. Eighteen records have come to notice, distributed from Maryland, the District of Columbia, and Virginia to Ohio, Illinois, Kentucky, Tennessee, Alabama, Oklahoma, and southern Texas. These records involve two races of the summer tanager, *rubra* and *cooperi*, and two of the cowbird, *ater* and *obscurus*.

Because of the small number of known cases of cowbird parasitism, it is somewhat unexpected to find that Stewart and Robbins (1958, p. 329) noted seven instances in Maryland. These seven probably

include the five Dorchester cases taken from the late F. C. Kirkwood's manuscript notes. Despite this, it begins to appear that in eastern Maryland the summer tanager must be a regular fosterer; however, even there it is not one of the most frequently chosen hosts.

In Oklahoma, Nice (1931, p. 173) has reported three records. In Nelson County, Kentucky, Beckham (1883, p. 141) called the bird an occasional victim. In Texas, it appears to be more than occasionally imposed upon; it has been recorded as a cowbird fosterer in several parts of the state. R. W. Quillin informed me many years ago that the summer tanager was a common host of the cowbird in the environs of San Antonio and he added that, in his extensive observations, he rarely found unparasitized nests of this bird. Simmons (1925, p. 172) similarly found it to be imposed upon in the Austin region, and Sutton (1938, p. 198) noted it in the same capacity in Tarrant County; it has been reported to be parasitized also in Brewster County by Van Tyne and Sutton (1937, p. 94).

Sutton wrote me that on May 15, 1935, he and J. B. Semple saw a pair of summer tanagers (*cooperi*) feeding a recently fledged cowbird near Hot Springs along the Rio Grande. This is the only actual record of this host rearing a young cowbird, but there is no reason to think the instance unusual.

Cardinal

Richmondena cardinalis (Linnaeus)

The status of the cardinal as a cowbird fosterer varies more in different parts of its range than is the case with most birds. In my original summary (1929, pp. 228–229) I observed that, while in some places the cardinal appears to be one of the commonest host species, in other areas it is very much the contrary. Recently, Berger (1951a, p. 29) reported that 10 out of 22 nests (45.4 percent) which were found by him in Michigan were parasitized—a notably high percentage. He noted that 7 of these 10 nests on which he had sufficient data to allow for analysis—containing at least 11 cardinal eggs and 13 cowbird eggs—produced no fledged cardinals and only two fledged cowbirds. He attributed this fact to the tendency of the cardinal to desert its nest when a cowbird lays in it. In the same general area, Sutton (1959, p. 81) noted that a cardinal deserted its nest and 4 eggs when a cowbird added its own to the clutch. Out of 21 cardinal nests observed by him, only 2 were victimized by the cowbird.

In the area about Nashville, Tennessee, Monk (1936, p. 33) reported that "local students have examined thousands of Cardinal nests with only one Cowbird record, indicating how very rarely this species is parasitized." Even allowing for loose writing and substituting "scores" for "thousands," the tendency seems clear. Laskey (1944a,

p. 33; 1944b, pp. 17–18), however, knew of at least nine cases of cowbird parasitism on the cardinal in Tennessee.

In the 35 years since I first summarized the status of this bird as a cowbird host, many dozens of additional records have come to notice; however, in most areas from which there is sufficient information the cardinal appears to be a relatively uncommon victim. Nevertheless, the total mass of instances allows no general evaluation other than to call this bird a regular and fairly common fosterer of the brown-headed cowbird.

All in all, about 75 records have been noted, distributed among the following states: Arizona, Arkansas, Delaware, Florida (Newman and Warter 1959), Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maryland, Michigan, Minnesota, Mississippi, Missouri, New Jersey, Ohio, Oklahoma, Pennsylvania, Tennessee, Texas, Virginia, and West Virginia; and Ontario (Essex and York Counties) in Canada. These records involve four races of the cardinal—*cardinalis, canicauda, superba, magnirostris*—and two races of the cowbird—*ater* and *obscurus*. The cardinal is parasitized chiefly in the central portions of its range.

A curious item is recorded by Alexander Wilson (1810, p. 40), who placed a nestling cowbird in a cage with a cardinal and found that the latter fed and reared the young bird "with great tenderness."

Pyrrhuloxia

Pyrrhuloxia sinuata (Bonaparte)

The pyrrhuloxia has been reported only six times to my knowledge as a victim of the brown-headed cowbird. According to information received from C. G. Abbott, a parasitized nest was found near Tucson, Arizona, by N. K. Carpenter. Another case was observed at Guaymas, Sonora, on June 25, 1928, by Griffing Bancroft. Both of these records refer to the race *fulvescens* of the host (not *sinuata* as I noted, 1934, p. 107) and the race *obscurus* of the parasite. Nyc (in litt.) discovered a nest five miles north of Raymondville, Willacy County, Texas, on April 22, 1952, with 3 eggs of the pyrruloxia and 1 of the dwarf brown-headed cowbird. In the files of the U.S. Fish and Wildlife Service, there are three additional Texas records: two parasitized nests found at Somerset by A. J. Kirn; and one, near San Antonio, reported by R. W. Quillin. These Texas records refer to the nominate race of the host.

Rose-breasted Grosbeak

Pheucticus ludovicianus (Linnaeus)

This is a fairly frequent victim of the brown-headed cowbird. Forty-three records have been noted, distributed from Saskatchewan, Ontario, and Quebec, in Canada, to the following of the United States:

New York, New Jersey, Ohio, Indiana, Illinois, Michigan, Wisconsin, Minnesota, Iowa, and North Dakota. The northwestern race of the parasite, *M.a. artemisiae*, is involved in the Saskatchewan and North Dakota records; the eastern race, *M.a. ater*, in all the others. Although most of the records merely refer to eggs in nests, the rose-breasted grosbeak has been known to rear young cowbirds to the fledgling stage. At Ithaca, New York, on July 6, 1922, I observed a pair of grosbeaks feeding an almost fully grown young cowbird. In southern Quebec, Terrill (1961, p. 9) noted three instances of parasitism in 42 nests examined.

Black-headed Grosbeak

Pheucticus melanocephalus (Swainson)

The black-headed grosbeak has been reported as a cowbird victim in only a few places in Kansas, Nebraska, Colorado, Utah, and Montana. In Lincoln County, Nebraska, Tout (1947) recorded the fact without giving any detailed cases. Sclater (1912, p. 401) wrote that this grosbeak is imposed upon not infrequently by the cowbird in Colorado, but he also gave no specific instances. Silloway (1917, p. 159) and A. A. Saunders (1914, p. 136, p. 143) reported parasitized nests from Montana, while Bee and Hutchings (1942, p. 82) found an instance at Utah Lake, Utah, on June 5. Mr. Guy Love informed me years ago that he found two parasitized nests in Decatur County, Kansas—one on June 11, 1909, and the other on May 25, 1912. The Kansas records refer to the eastern race of the cowbird, *M.a. ater*, whereas the others relate to the northwestern race, *M.a. artemisiae*. All involve the nominate race of the host.

Recent studies of hybridization between the rose-breasted and the black-headed grosbeaks suggest that the two are related very closely. Although outside the interest of the present study, it should be mentioned that there is no apparent difference between the two birds in their relation to cowbird parasitism. As far as our present knowledge goes, the cowbird treats them alike.

Blue Grosbeak

Guiraca caerulea (Linnaeus)

The blue grosbeak is a fairly frequent victim of the brown-headed cowbird, but, at times and in certain localities, it may be imposed upon very much. Whereas in most areas it has been recorded as a host on the basis of one or a very few instances, the opposite is the case in some areas, as seen in the experience of Bleitz (1956) in southern California. In a single season, within the limits of a very restricted locality, he found seven nests of the blue grosbeak, every one of which had been parasitized. If this were a typical or even fairly usual condition, it could be expected that many more instances would have

found their way into print, but they have not. The report serves to caution against generalizations too easily derived from negative or insufficient data as to the status of this species as a cowbird host. Similarly, in Decatur, Arkansas, Plank (1919, p. 18) wrote that the blue grosbeak "is one of the worst preyed-on birds. In a nest near a pasture a few years ago I found three Cowbird's eggs in various stages of incubation and one Grosbeak's egg nearly ready to hatch. Another nest contained two Cowbird's eggs and two Grosbeak's. One rarely finds a nest of this species that has not been visited by a Cowbird." In Woods County, Oklahoma, Mr. Guy Love collected no fewer than five parasitized sets of eggs, which suggests a high incidence of cowbird parasitism there. All in all, I have noted about 30 cases of parasitism on the blue grosbeak.

The cases are distributed among the following states: Arkansas, California, Kansas, Maryland, Mississippi, New Mexico, Oklahoma, Texas, and Virginia. The total number of records involves three races of the grosbeak: *salicaria* in southern California; *interfusa* in Texas, Oklahoma, and New Mexico; and *caerulea* in the other areas that were listed. Two cowbird races are involved in these records: *obscurus* with *salicaria* and *interfusa; ater* with *caerulea* and *interfusa*.

Previously unpublished and—as far as I know—the only record from New Mexico is a set of eggs with 1 of the cowbird, taken in Eddy County on June 18, 1923, by E. E. Pilquist and now in the Cruttenden collection at Quincy, Illinois.

Evidence of the ability of this grosbeak to rear young of the parasite is afforded by the record of a young cowbird and a young grosbeak reared together at Norman, Oklahoma (Nice, 1931, pp. 174–175).

Indigo Bunting

Passerina cyanea (Linnaeus)

The indigo bunting is a very frequent host of the brown-headed cowbird. About 200 records have been noted, distributed in Ontario and Quebec, in Canada, and the following of the United States: Alabama, Arkansas, California, Connecticut, Delaware, Illinois, Indiana, Iowa, Kansas, Kentucky, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Jersey, New York, Ohio, Oklahoma, Pennsylvania, Rhode Island, Virginia, West Virginia, and Wisconsin. These records all involve the eastern race of the cowbird, *M.a. ater*, with the exception of one record from Soledad Canyon, California, where Bleitz (1958) found that the indigo bunting was victimized by the southwestern race of the parasite, *M.a. obscurus*.

In some areas, a fairly high percentage of the nests contain eggs of the cowbird. In Ohio, Hicks (1934) found 43 nests, of which 17,

or nearly 40 percent, were parasitized; also in Ohio, Phillips (1951) found 14 nests, of which 6, or 42.8 percent, were parasitized. The latter observer reported that, in the total 14 nests, 41 bunting eggs and 7 cowbird eggs were laid; these produced 18 fledged buntings (43.9 percent) and one fledged cowbird (14.3 percent).

In his study of this bunting, Twomey (1945, pp. 193–195) found that 12 out of 33 nests, observed during two successive years, were parasitized. In most of these cases, fatalities to some of the host young occurred: about 30 percent of those that hatched failed to reach the fledging stage. Twomey studied the growth of the nestlings of both host and parasite and found that the presence of a young cowbird decreased the growth rate of the young buntings which were its nest-mates and that the presence of two young cowbirds in a nest proved fatal to the young of the fosterer. Using Twomey's data, Lack (1947, p. 323) attempted to equate one young cowbird with two young buntings in the factor of feeding by the host adults.

In the Edwin S. George Reserve of southeastern Michigan, Sutton (1959, pp. 95–99) found 26 nests of the indigo bunting, of which 4 were parasitized. In these 26 nests, 53 bunting and 6 cowbird eggs had been laid. Of these, 44 bunting and 3 cowbird eggs hatched; of the 44 bunting chicks, 23 fledged successfully. None of the parasitized nests produced fledglings of either parasite or host.

In southern Quebec, Terrill (1961, p. 9) found 30 nests, of which 6, or 20 percent, were parasitized. In most places where it is parasitized, the indigo bunting appears to be a frequently chosen fosterer. Ordinarily, it does not attempt to rid itself of the strange eggs so frequently foisted upon it, but one instance has come to my notice of an indigo bunting burying under a new nest lining a cowbird egg which had been deposited before the host had laid any of its own.

On other occasions, as indicated above, the indigo bunting has been known to rear young cowbirds to the fledging stage. I saw two such cases at Ithaca, New York, in 1921 and 1922, and one of the earliest and one of the most complete accounts of this finch as a cowbird fosterer—published by Ord in 1836 (pp. 68–69)—gives a detailed record of the development of two young cowbirds in an indigo bunting's nest. As many as 5 eggs of the cowbird have been reported in a single next of this host (Pius, 1949) and as many as two young cowbirds have been known to be reared in one nest (Ord, loc. cit.; Bradley, 1948).

Lazuli Bunting

Passerina amoena (Say)

The lazuli bunting is known as a victim of the brown-headed cowbird in California, Colorado, Idaho, Montana, and Washington. Two races of the parasite are involved—*obscurus* in southern Califor-

nia, where Hanna (1928, p. 161) and Stoner (1937) recorded four parasitized nests, and *artemisiae* in the following instances: in Colorado, where Sclater (1912, p. 405) noted one nest with an egg of the parasite and where Acken and Warren (1941, p. 575) recorded another near Bear Creek on July 19, 1898; in Idaho, where Bendire collected a parasitized set of eggs on June 21, 1871; in Montana, where B. Bailey (1914, p. 143) collected a similar clutch of mixed eggs; and in Washington where Decker found the lazuli bunting to be a cowbird victim (Jewett, Taylor, Shaw, and Aldrich, 1953, p. 594) and where King (1954, pp. 150–154) found two parasitized nests in Whitmore County.

Varied Bunting

Passerina versicolor (Bonaparte)

The varied bunting is a very slightly known bird; it is included as a victim of the southwestern race of the brown-headed cowbird, *M.a. obscurus,* on the basis of only two records. R. D. Camp collected a set of 2 eggs of this bunting with 1 of the cowbird in Cameron County, Texas, on June 4, 1927; the set later became part of the J. Hooper Bowles collection. A second record, the date and locality of which are unknown to me, is based upon a parasitized set of eggs in the collection of J. C. Braly of Portland, Oregon. These records refer to the typical race of the varied bunting.

Painted Bunting

Passerina ciris (Linnaeus)

The painted bunting is a fairly frequent victim of the brown-headed cowbird and, in some areas, it appears to be a very common host. About 50 records have been noted from Oklahoma, Texas, and Mississippi. In southern Texas, the parasite is the small race of the cowbird, *M.a. obscurus;* in Oklahoma and Mississippi, it is the eastern race, *M.a. ater.* Two races of the painted bunting are involved: *P.c. pallidior* in southern Texas; *P.c. ciris* in Oklahoma, northern and central Texas, and Mississippi.

Mr. R. W. Quillin wrote to me many years ago that this bird is one of the commonest victims of the cowbird around San Antonio, Texas. According to him, the bunting does not tolerate the imposition of the parasite as well as some other birds do and, in about eight cases out of ten, the buntings desert their nests when a cowbird lays in them. When the bunting has completed or nearly completed its set of eggs is the time that it will usually tolerate the addition of the strange egg.

Parmalee (1959), pp. 1–18) has added greatly to our knowledge of the situation, particularly in southern Oklahoma. Out of 45 nests found in 1957, 13 were parasitized and all but 4 of these were de-

serted by the buntings during the egg-laying period. He suggests that nest desertion occurs if the nest is parasitized early in egg-laying before the third or fourth egg of the host is laid. No nest had more than 2 cowbird eggs and, in at least two nests, young of both parasite and host matured to the fledgling, nest-departing stage.

More records of cowbird parasitism on this bunting are from Texas than elsewhere. Besides Quillin's statement, mention should be made, among others, of Nyc (1939, p. 87), Simmons (1925, p. 172), and Savary (1936, p. 62).

Dickcissel

Spiza americana (Gmelin)

The dickcissel is a not uncommon victim of the brown-headed cowbird. About 55 instances have been reported from Arkansas, Illinois, Indiana, Iowa, Kansas, Michigan, Nebraska, Oklahoma, and Texas. In southern Texas, it is parasitized by the small race of the cowbird, *obscurus;* elsewhere, by the eastern race, *ater.* R. W. Quillin informed me many years ago that around San Antonio, Texas, he had examined hundreds of dickcissel nests and had found cowbird eggs in only four cases. Philo Smith, Jr. (1882, p. 182), reported as many as 4 cowbird eggs with 3 of the owner in one dickcissel nest. This species is not bothered by the cowbirds to the same degree that some other ground-nesting birds are. Judging by the published records, it appears to be imposed upon more often in Texas, Oklahoma, Nebraska, and Kansas than elsewhere. In addition to Quillin's San Antonio records, there are others from Texas—the Austin area (Simmons, 1925, p. 172) and Brenham (Nyc, 1929, p. 87). In 1907 at Lawrence, Kansas, Hanna collected three parasitized sets which are now in the collections of the California Academy of Sciences. According to information received from R. F. Johnston (in litt.), 6 out of 23 nests found in one area in Kansas were parasitized—an incidence of 25 percent. Overmire (1962, pp. 115–116) recorded a higher frequency of parasitism in Oklahoma, where he found that 19 out of 61 dickcissel nests (31 percent) contained eggs of the cowbird—not one of which survived to the hatching point. The highest frequency of cowbird parasitism which I have yet found is 53 percent: reported in Nebraska by Hergenrader (1962, pp. 85–88).

Evening Grosbeak

Hesperiphona vespertina (Cooper)

This species is included in the present list on the basis of a single observation, which was made at Saranac Lake, New York, in July, 1949. The case already has been described in detail by Schaub (1949) and by Nichols (1949). It involves a fledgling cowbird

which came to a feeding shelf with an adult male grosbeak; the fledgling was fed repeatedly by the latter. As yet, no nest of the evening grosbeak has been found with eggs or young of the parasite; for this reason it cannot be said with certainty that the cowbird in question actually was reared by the apparent fosterer, but the indication that it was is very strong. The record refers to the nominate race of both victim and parasite.

Purple Finch

Carpodacus purpureus (Gmelin)

The purple finch is a very uncommon victim of the brown-headed cowbird. Eighteen records have been noted, distributed among the following areas: Alberta, Saskatchewan, and Quebec in Canada; California, Washington, Michigan, Connecticut, New York, and Rhode Island in the United States. In California, Washington, Alberta, and Saskatchewan the parasite is the race *artemisiae;* elsewhere, it is the eastern race *ater.* In all cases the nominate race of the victim is involved.

Sage and Bishop (1913, p. 110) record two nests in Connecticut, each with a cowbird's egg. In addition to this there is another Connecticut record, a nest with 3 cowbird eggs and 4 of the host, listed by Hoffman (1881, p. 53). Still another parasitized nest from the same state was taken near New London on May 26, 1887, by C. L. Rawson and later was incorporated into the J. P. Norris collection. Nearby, in Rhode Island, two more cases were found, one at Warwick on June 13, 1882, and one at Cranston on May 30, 1902; both sets of eggs are now in the C. E. Doe collection in the Florida State Museum. Several cases have been noted in New York, of which two may be mentioned: at Ithaca, Alberger (1890, p. 46) recorded a parasitized nest; at Mayville, Kibbe (1892, pp. 133–134) found another on June 8, 1892.

Mr. T. E. Randall informed me that he had found three instances of cowbird parasitism on the purple finch in Alberta. Street (Houston and Street, 1959, p. 176) reported this finch as a cowbird host in Saskatchewan. The lone Washington record (from the files of the British Columbia Nest Records Scheme, Univ. of B.C.) is a nest containing 3 eggs of the finch and 1 of the cowbird, found two miles south of Orrondo, Douglas County, on June 25, 1959. This record was sent to me with a note that the observer (name not given) was not entirely certain as to the identity of the host but considered it to be a purple finch. In southern Quebec, a single case was reported by Terrill (1961, p. 9); an earlier one had been recorded by Lloyd (1944, p. 172) from Hull on May 28, 1899. The National Museum of Canada has a parasitized set, taken at Hull, by A. R. Legge on May 28, 1897. This may be the same one mentioned by Lloyd. In the collections of

the Santa Barbara Museum of Natural History there is a parasitized set of eggs of the purple finch, taken at Smith's Camp, Bishop, California, May 7, 1922.

House Finch

Carpodacus mexicanus (Müller)

The house finch appears to be imposed upon only occasionally by the brown-headed cowbird. Ten instances have come to my notice: one record from New Mexico, where Jensen (1925, p. 461) found this finch was parasitized in northern Santa Fe County; three records from southern California—Buena Park (Robertson, 1931a, p. 138; 1931b, 205), the San Bernardino Valley (Hanna, 1933, p. 205) Bloomington, San Bernardino County (a set in the San Bernardino County Museum); two from Arizona, where Hensley (1954, p. 204) noted a house finch deserting its parasitized nest and where he later (1959, p. 91) reported a parasitized nest in the Organ Pipe Cactus National Monument; one record from Texas, where Nyc (in litt.) informed me that he had found the nest of a house finch with 3 eggs of the host and 1 of the dwarf cowbird at Kerrville, Kerr County, on May 14, 1938; a recent record from Oregon, where Alderson (1960, p. 22) recorded two parasitized nests at North Portland, on May 22, 1960; and one from California, where Mr. E. Z. Rett, informed me that, in the files of the Santa Barbara Museum of Natural History, there is a card for a set of 5 eggs of the house finch and 1 of the cowbird, collected at Smith's Camp, Bishop, California, in May, 1922, but the eggs themselves could not be found at the time of his writing.

The parasite in the last instance and in the Oregon cases was of the race *artemisiae;* in the New Mexico record it was of the eastern race *ater;* in the Arizona and southern California records, the dwarf race *obscurus*. In all the records the race of the house finch was *C.m. frontalis*.

White-collared Seedeater

Sporophila torqueola (Bonaparte)

This bird is a little known victim of the brown-headed cowbird. It was established previously as a molothrine host only on the basis of its inclusion in the list of hosts in Bendire's pioneer study (1895). The following definite records may now be added to this otherwise unsupported statement. In the Cruttenden collection, Quincy, Illinois, there is a set of eggs of this seedeater with a single egg of the dwarf race of the brown-headed cowbird, collected "in Mexico" on June 5, 1947. Meitzen (in litt.) found a parasitized nest near Brownsville, Texas. Fred F. Nyc, Jr., also wrote me that in Cameron County, Texas, and in the adjacent portions of Tamaulipas he found several dozen nests of this seedeater, of which three were parasitized. Two of these each held 2 eggs of the host and 1 of the parasite.

The third case was more involved as indicated in the following description. On July 15, 1947, when first examined, the nest contained 2 eggs of the seedeater; the next morning there was a cowbird egg in it as well; four days later a 2nd cowbird egg was laid in it, apparently by a different female as far as could be judged from the dissimilarity of the eggs; two days later Nyc removed the last laid egg and a few minutes later the female host was back on the nest, incubating. After four days, the first cowbird egg hatched; that same day Nyc removed the young parasite. The next day one of the host's eggs was missing and a new, 3rd, cowbird egg was in the nest. Three days later the nest was empty and deserted; a snake in the same tree was thought to have been the predator.

All the records refer to the race *sharpei* of the host and the race *obscurus* of the parasite.

Common Redpoll

Acanthis flammea (Linnaeus)

Since most of the breeding range of this boreal finch is north of that of the brown-headed cowbird, the redpoll generally is unavailable as a host. A single instance of its being parasitized has been brought to my attention from the files of the British Columbia Nest Records Scheme. A nest of the common redpoll (*A.f. flammea*) containing 1 egg of its own and 1 of the cowbird (*M.a. artemisiae*) was found at Castor, Alberta, on June 25, 1959. The nest was deserted when found and both eggs were in addled condition.

Pine Siskin

Spinus pinus (Wilson)

Generally, the pine siskin is ecologically allopatric with the brown-headed cowbird, a fact which effectively protects it from the attentions of the parasite. However, there are places where the two species overlap and here the siskin occasionally is imposed upon. Eleven such instances have come to my notice, distributed among the following states: Iowa, Kansas, Nebraska, South Dakota; and in Canada: Ontario and British Columbia.

Klugh (1906, pp. 17–18) recorded three parasitized nests in Wellington County, Ontario. These were the first cases to be known. Dales and Bennett (1929, pp. 74–77) recorded a nest in Iowa containing 3 eggs of the siskin and 1 of the cowbird. The latter egg hatched and the chick grew to the fledging stage as the sole survivor of the brood. Swenk (1929, pp. 79, 82) noted two parasitized nests in Nebraska: one at Child's Point, south of Omaha, on May 13, with 3 eggs of the siskin and 1 of the cowbird; another at Lincoln, on May 16, with one young siskin in the nest and a young cowbird on the ground beneath

it. The two adult siskins were observed feeding both of the young birds.

At Hays, Kansas, on April 28, 1961, Dr. Charles Ely found a cowbird egg and an egg of the host in a pine siskin's nest. On May 5 only the cowbird egg remained; on May 8 a 2nd cowbird egg had been laid in the nest. Krause (1954, p. 42) found six nests of the pine siskin at Sioux Falls, South Dakota, one nest of which contained a cowbird's egg. Dr. Ian McTaggert Cowan informed me that a parasitized nest was found at Enderby, British Columbia. This and Krause's South Dakota record are the only instances I have noted in which the northwestern race of the parasite, *M.a. artemisiae*, was involved; all the other cases refer to *M.a. ater*. The race of the host in all these instances is the typical one *S.p. pinus*.

American Goldfinch

Spinus tristis (Linnaeus)

In some parts of its range the goldfinch breeds so late in the summer (from July to mid-September in many northern portions) that it obviously becomes unavailable as a host for the brown-headed cowbird; but the overlap elsewhere is sufficient to enable the latter to parasitize this bird rather frequently. This fact is due to variations not only in the date of inception of breeding by the goldfinch but also in the date of termination of egg-laying by the cowbird. Jensen (1918, p. 347), writing of the birds of Wahpeton, North Dakota, reported a nest of the goldfinch with 4 newly-laid eggs of its own and 1 of the cowbird on August 6—over a month later than my latest date for a cowbird's egg in central New York.

Some 53 records have been noted: from British Columbia, Alberta, Saskatchewan, Ontario, and Quebec in Canada; from California, Connecticut, Illinois, Indiana, Iowa, Massachusetts, Michigan, Minnesota, Missouri, New York, North Dakota, Ohio, Oklahoma, Pennsylvania, and Wisconsin in the United States. In most areas the goldfinch is a rare victim; in southern Quebec, Terrill (1961, p. 9) found 313 nests during nearly 60 years of observing, and of these only 7 contained eggs of the cowbird. Similarly, at Ithaca, New York, an area where both the goldfinch and the cowbird are common and where many nests of the former had been found prior to the end of my work there in 1923, no instances of cowbird parasitism on this bird were on record. In his extensive study of the goldfinch in southern Michigan, Nickell (1951) noted 264 nests but he mentioned cowbirds in connection with only a single instance—a nest which had been abandoned with three young cowbirds in it. The presence of the parasites was not linked directly or inferentially with the abandonment of the nest. In the same region, Walkinshaw

(1938, pp. 3–11) observed 111 nests, not one of which had been parasitized. Berger (1960, p. 118) in the same general area found 796 nests, of which 11 were parasitized. Three of these cases were two-storied nests and two were reported in an earlier paper (Berger, 1948, pp. 52–53).

Conversely, Eaton (1914, p. 227) lists the goldfinch as one of the common victims of the cowbird in New York, and so it seems that considerable local variation must occur. In southern California the goldfinch apparently is a frequent fosterer. Hanna (1928, p. 161) recorded eight parasitized nests in a limited area and a limited time, and M. C. Badger wrote me that, in his experience, the goldfinch was a very common victim in southern California.

In the absence of recent records of a cowbird being fledged from a goldfinch's nest, Berger (1961, p. 271) considered it unlikely that the young parasite could survive on a diet of regurgitated seeds such as the goldfinch habitually gives its nestlings. Nevertheless, this phenomenon has occurred. The earliest recorded instance, observed near Baltimore, Maryland, and described by Dr. Nathaniel Potter, is given in full in Alexander Wilson's pioneering work on American birds (1810, p. 158).

The records relate to three races of the goldfinch—*tristis*, *pallidus*, *salicamans*—and to the three races of the cowbird: *obscurus* in California; *artemisiae* in British Columbia, Alberta, Saskatchewan, and North Dakota; and *ater* elsewhere.

Lesser Goldfinch

Spinus psaltria (Say)

The lesser goldfinch has been reported on a few occasions as a victim of the brown-headed cowbird in California and Texas. The late J. Hooper Bowles informed me many years ago that he had in his collection a set of 4 eggs of this goldfinch with 1 of the cowbird, taken at Santa Paula, California, by M. C. Badger. The collector wrote me that he had found this bird to be an occasional victim but that it was not as frequently imposed upon as its congener, *S. tristis*. Woods (1930, p. 126) recorded another parasitized nest at Azusa. A. M. Ingersoll and Griffing Bancroft have both found similar cases in San Diego County; there are three sets taken by them in the collection of the Western Foundation of Vertebrate Zoology and one in the San Diego Museum of Natural History. In the collection of the San Bernardino County Museum there is a parasitized nest of eggs taken in the San Gabriel Mountains. All these California records relate to the race *hesperophilus* of the host and the race *obscurus* of the parasite.

The data from Texas is incomplete. The late G. F. Simmons wrote me that, shortly after the publication of his book on the birds of the Austin region (1925), he was informed of a local instance of cowbird parasitism on this goldfinch. The race of this bird breeding in the Austin area is the nominate one, *S.p. psaltria.*

Lawrence's Goldfinch

Spinus lawrencei (Cassin)

This goldfinch is known as a victim of the brown-headed cowbird on the basis of two records, both from southern California. H. R. Eschenberg informed me that he had found a nest with 4 eggs of the goldfinch and 1 of the dwarf race of the cowbird at Gilroy, on June 20, 1934. In the collections of the Museum of Vertebrate Zoology at Berkeley, there is a set of 1 egg of this host and 2 of the dwarf cowbird, collected at Candalanga, Ventura County, by Ashworth.

Red Crossbill

Loxia curvirostra (Linnaeus)

On the whole, the red crossbill is ecologically allopatric with the brown-headed cowbird, and thus it is generally unavailable as a host for the latter. There is only a single case of cowbird parasitism on record. Saunders and Dale (1933, p. 240) collected a nest with 3 eggs of the crossbill and 1 of the cowbird on April 29, 1909, two miles east of London, Ontario. This instance refers to the race *minor* of the crossbill, as now understood; previously I (1938, p. 49) had listed this record as *L.c. pusilla,* a name now restricted to the population breeding in Newfoundland. The cowbird involved is the typical eastern race, *M.a. ater.*

Olive Sparrow

Arremonops rufivirgata (Lawrence)

The nominate race of this sparrow is known as a victim of the small race of the brown-headed cowbird, *M.a. obscurus,* on the basis of only a few records. Merrill (1878, p. 130) listed it as a cowbird victim at Brownsville, Texas; Sennett (1879, p. 396) also listed it. Probably on the bases of one or both of these statements, Bendire (1895, p. 442) included this sparrow as a victim of the dwarf cowbird. In the files of the U.S. Fish and Wildlife Service there are two records, both from southern Texas. Mr. John B. Hurley informed me that he has in his collection a parasitized set of eggs of this bird collected in Cameron County, Texas, on July 12, 1927, by R. D. Camp. F. F. Nyc, Jr. (in litt.), found two more parasitized nests near Brownsville, Cameron County, Texas.

Green-tailed Towhee

Chlorura chlorura (Audubon)

The green-tailed towhee has been reported a few times as a host of the brown-headed cowbird in Colorado, New Mexico, and California. Henshaw (1875, p. 308) recorded finding a cowbird egg in a nest of this bird at Fort Garland, southern Colorado, (originally reported by Yarrow, 1874, p. 82); Rockwell (1908, p. 173) listed this towhee as one of the favorite hosts of the parasite in Mesa County, Colorado. In the collections of the Western Foundation of Vertebrate Zoology there is a parasitized set of eggs from Beaver Creek, Colorado, taken on June 6, 1897, and another from Santa Fé, New Mexico, collected on June 12, 1923. Mitchell (1898, p. 309) considered this towhee one of the most frequently imposed upon victims in San Miguel County, New Mexico. Mr. N. K. Carpenter informed me many years ago that he had found a parasitized nest in Mono County, California. The Colorado and New Mexico observations refer to the eastern race of the cowbird, *M.a. ater;* the California one, to the race *M.a. artemisiae.*

Rufous-sided Towhee

Pipilo erythrophthalmus (Linnaeus)

The rufous-sided towhee is a very frequent victim of the brown-headed cowbird. Nearly 300 records have been noted, distributed as follows· Alberta, British Columbia, Manitoba, Ontario, Quebec, and Saskatchewan in Canada; Arkansas, California, Colorado, Connecticut, Delaware, District of Columbia, Illinois, Indiana, Iowa, Kansas, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Montana, Nebraska, New Jersey, New York, North Dakota, Ohio, Pennsylvania, Rhode Island, South Dakota, Tennessee, Virginia, West Virginia, and Wyoming in the United States. These records involve eight races of the towhee—*erythrophthalmus, canaster, arcticus, montanus, curtatus, oregonus, falcifer,* and *megalonyx*—and all three races of the cowbird: *ater, artemisiae,* and *obscurus.*

Not only is this towhee victimized over a vast, transcontinental area, but also, in many parts of its range, it is one of the chief mainstays of the cowbird. It has been called one of the commonest hosts in New York by Eaton (1919), in Connecticut by Sage and Bishop (1913), in Ohio by Jones (1903), in Indiana by Evermann (1889), in Iowa by Anderson (1907), etc. In Ohio, Hicks (1934) found 103, nests in the course of many years of local observation, and 22 of these, or more than 20 percent, had been parasitized by the cowbird.

In California, on the contrary, Baumann (1959, pp. 191–193) knew of only two instances of parasitism (Harmon, 1928, p. 161; Rowley, 1930, p. 131). He noted that the presence of an adult

cowbird seemed to disturb the towhees greatly but he observed no parasitism. Davis (1960, p. 455) also commented on the scarcity of instances in California but he predicted that the spread and increase of the brown-headed cowbird in coastal California would result in more frequent usage of towhees' nests by the parasite. A parasitized set of eggs, taken near Riverside, is now in the San Bernardino County Museum.

The towhee is one of the larger of the regular victims of the cowbird. With none of its fosterers is the parasite more successful. I have learned of no case of a towhee covering over, or in any way trying to get rid of, the strange eggs. Moreover, no host has been saddled so often with large numbers of parasitic eggs; the highest total found in a single nest was 8 cowbird eggs together with 5 of the towhee, a set taken in northern Iowa. Sanborn and Goelitz (1915, p. 444) found a nest in Lake County, Illinois, also with 8 cowbird eggs, but with only a single egg of the towhee. There are other records of nests with 8, 6, 5, and 4 cowbird eggs, but, unfortunately, none of these were watched to see what the outcome would be. Most of them were collected as specimens for egg collections—after the manner of the time in which they were found.

In other nests, with smaller numbers of eggs, the rufous-sided towhee has been found to rear the young cowbirds to the fledging stage. There is, however, a dearth of information as to the frequency with which any of the rightful brood survive with the parasite. This is a case wherein observers have failed to place data on record, probably because of their feeling that the occurrence was too common to be worth reporting.

Brown Towhee

Pipilo fuscus Swainson

The brown towhee has been reported as a victim of the brown-headed cowbird a few times in north-central New Mexico, Arizona, and California. Griffing Bancroft informed me many years ago (Friedmann, 1934, pp. 109–110) that he had in his collection two parasitized sets of eggs of this bird; of the race *mesoleucus*, they had been collected in Santa Fe County, New Mexico, on June 4 and 12 of that year. A third and similar set was without precise data; taken at Santa Fe, New Mexico, on June 12, 1925, it is now in the collection of the Western Foundation for Vertebrate Zoology. Another parasitized set of eggs, taken near Tucson, Arizona, on May 18, 1936, is now in the collections of the Carnegie Museum. J. T. Marshall, Jr. (in litt.) wrote to me that, in the few nests of the brown towhee which he found in the mesquite covered areas near Tucson, Arizona, there were no cowbird eggs but that, in nearby desert localities, R. S. Crossin

had found parasitized nests of this species. In the collections of the Hancock Foundation at the University of Southern California there is an egg of the brown-headed cowbird, from a nest of a brown towhee collected at Alhambra, California, on June 13, 1944. The host in that area is the race *P.f. senicula.* The Arizona and California records involve the southwestern race of the parasite, *M.a. obscurus;* the New Mexico ones refer to the nominate race, *M.a. ater.*

Abert's Towhee

Pipilo aberti Baird

Abert's towhee is a rather poorly known and little studied species, but it has been found to be parasitized by the small race of the brown-headed cowbird, *M.a. obscurus,* at least nine times in southern Arizona and at least once in California (Westmoreland, Imperial County). The latter set is now in the San Bernardino County Museum. Brown (1903, p. 47) merely reported it as a molothrine victim in Arizona without giving any actual instances. G. F. Breninger, however, collected a parasitized set of eggs at Phoenix, on May 2, 1896, a set now in the collections of the California Academy of Sciences. As recorded in my first account (1929, p. 228), A. B. Howell found a parasitized nest about four miles southwest of Gadsden, on May 20, 1918. The late J. Hooper Bowles wrote me that he had in his collections two more records, one collected at Mesa on May 14, 1919, and one from the same place on June 19, 1921. One nest contained 2 eggs of the host and 2 of the parasite and the other held 3 eggs of each.

J. T. Marshall, Jr. (in litt.) informed me that, in the mesquite woods of the San Xavier Reservation, ten miles south of Tucson, Arizona, he noted four parasitized nests of Abert's towhee. He wrote me that this bird usually started to nest before the cowbirds arrived in the spring and that the early broods have a chance of coming to successful fruition without interference by the parasite. Another record from Tucson is a parasitized set of eggs, taken in 1917 and now in the Santa Barbara Museum of Natural History.

The various records given above involve both races of the host, *aberti* and *dumeticolus.*

Rusty-crowned Ground Sparrow

Melozone kieneri (Bonaparte)

J. Stuart Rowley (mss.) found that this sparrow frequently was parasitized by the bronzed cowbird in Morelos, Mexico; but in one nest he also found an egg of the brown-headed cowbird, *M.a. abscurus.* The local race of the host is *M.k. rubricatum.*

Lark Bunting

Calamospiza melanocorys (Stejneger)

The lark bunting apparently is a fairly common local victim of the northwestern race of the brown-headed cowbird, *M.a. artemisiae*, but if the species is considered in a general, comparative way, it is a rather infrequent victim. J. A. Allen (1874, pp. 58–59) observed the bird in the Dakotas and Montana and found that, "in a series of eighteen nests, five, or nearly one-third, contained eggs of the Cowbird, two even containing two each, and one had three; while out of twenty-nine nests of other ground-nesting prairie birds, collected at the same time and over the same area, *not one* contained an egg of the Cowbird . . . ." He concluded that the cowbird formed "no inconsiderable check upon the increase of this bird." Coues (1874, p. 164, and 1878b, p. 597) wrote that eggs of the cowbird frequently were found in nests of the lark bunting, and Hoffman (1875, p. 172) noted a parasitized nest in North Dakota.

All of the foregoing information was included in my first account (1929, p. 232). It is strange that, in the succeeding years, only one additional record has come to my attention: a parasitized set of eggs taken in McHenry County, North Dakota, on June 9, 1933, and now in the Brandt Collection of the Carnegie Museum. When we consider that the most recent of the earlier cases was prior to 1878, it is all the more surprising that supplementary information has not been forthcoming. This phenomenon cannot be blamed completely on the dropping off of interest in egg collecting, but, at the same time, there is no reason for thinking that the lark bunting has become immune to cowbird parasitism.

Savanuah Sparrow

Passerculus sandwichensis (Gmelin)

The savannah sparrow is a very infrequent victim of the brown-headed cowbird. Although the geographic spread of the recorded instances of cowbird parasitism is extensive, there are no more than a few records in any area, and in most there are only single or scattered reports. Twenty-eight records have been noted, distributed as follows: Alberta, Manitoba, New Brunswick, Ontario, Quebec, and Saskatchewan in Canada; Colorado, Maine, Michigan, Montana, New York, North Dakota, Ohio, Oregon, and Utah in the United States. The records involve four races of the sparrow: *labradorius* in New Brunswick; *oblitus* in Manitoba, Montana, North Dakota, and Wisconsin; *nevadensis* in Alberta, Saskatchewan, Colorado, Oregon, and Utah; *savanna* in Ontario, Quebec, Maine, Michigan, New York, and Ohio. Two races of the cowbird, *ater* and *artemisiae*, are involved.

The one record found for *labradorius* is a nest with 4 eggs of the sparrow and 1 of the cowbird, collected at Grand Menan, New Brunswick, on July 2, 1883, by G. M. Cheney; from him it passed into the J. P. Norris collection.

Of the race *oblitus* the following instances may be mentioned. F. S. Hersey collected a parasitized set of eggs at Lake Winnepegosis, Manitoba, on June 2, 1913; this set is now in the Bent collection in the U.S. National Museum. Other cases were recorded by Coues (1878, p. 588) in Montana and North Dakota and by Barger (1940, pp. 91–94) in Wisconsin.

Of the race *nevadensis,* mention should be made of two parasitized nests found in Alberta by T. E. Randall in addition to another nest from that area, all recorded by Horsbrugh (1915, p. 688); a number of similar instances in Oregon was given by Jewett (1936, p. 46) and by Gabrielson and Jewett (1940, p. 530); in Saskatchewan, by Bent (1908, p. 28) and by Ferry (1910, pp. 199–200). In Utah, Clarence Cottam found a parasitized nest near Utah Lake, four miles west of Provo, on May 17, 1928, and in Colorado a similar instance was found by E. R. Warren (1910, p. 36).

A notable addition to the available data for the race *savanna* comes from southern Quebec, where Terrill (1961, p. 10) found 5 parasitized nests out of a total of 140 occupied nests of this sparrow which he had examined over a period of nearly 60 years of field study. Middleton (*in* Detroit Audubon Society, 1956, p. 92) found one such case at Mt. Clemens, Michigan, on June 2, 1954. Older records which should be mentioned here are Snyder and Logier (1930, pp. 194–195) in Ontario, Friedmann (1929, p. 218) in New York, and Vasicek (1935) in Ohio. The eastern race *savanna* has been known to rear the young cowbird to the fledging stage.

Even though we now have 28 records and undoubtedly others will be found, it appears safe to say that the savannah sparrow is molested infrequently, that it is not of great importance in the economy of the brown-headed cowbird, and that the parasite is not a serious factor in the welfare of the sparrow.

Grasshopper Sparrow

Ammodramus savannarum (Gmelin)

This secretive denizen of grassy fields is difficult to observe, and, as a result, its nests very seldom are discovered. Three races—*pratensis, perpallidus, ammolegus*—however, have been found to be parasitized by the brown-headed cowbird. The number of records is small, 11 in all, distributed from Manitoba in Canada to the "northeastern United States," and Maryland, Ohio, Indiana, Michigan, Kansas, Nebraska, Texas, and Arizona. The race *perpallidus* is

parasitized by two subspecies of the cowbird, *artemisiae* and *ater; pratensis* is molested by *ater;* and *ammolegus,* by *obscurus* (one record, a parasitized nest from Arizona, now in the collections of the Carnegie Museum).

Considering the difficulty of finding the nests of this bird, Price's experience (1934, pp. 107–108) is exceptional. He examined about 100 nests in Paulding County, Ohio, and found cowbird eggs in 2 of them. This is the only even slightly quantitative data available as to the frequency of parasitism on this host.

A review of the actual records, all previously listed in my earlier summaries (1929, p. 219; 1931, p. 62; 1934, p. 110; 1938, p. 49), reveals that no one has ever attempted to study a parasitized grasshopper sparrow: all that the cases show is that eggs of the parasite were seen in nests of this bird. No one has yet recorded this host as rearing a young cowbird, but there is no reason to assume that it can not and does not do so. It seems probable, however, that the grasshopper sparrow and the cowbird are of little importance to each other as host and parasite.

Baird's Sparrow

Ammodramus bairdii (Audubon)

So little is known of the life history of this sparrow that it is not possible to estimate the extent to which the bird is affected by the parasitism of the cowbird. There are only six records—from Manitoba and North Dakota—and one without definite locality. Raine (1894, p. 71) reported a nest of Baird's sparrow with 2 eggs of its own and 3 of the cowbird. No locality was given, but it was either in Montana or in some adjacent area of Canada. Alfred Eastgate wrote me many years ago that he had found a parasitized nest in North Dakota. L. B. Bishop collected two parasitized sets of eggs near Devil's Lake, North Dakota. B. W. Cartwright wrote me that T. S. Roberts found a nest with 4 eggs of the sparrow and 2 of the parasite in northern Sargent County, North Dakota, on June 18, 1883. Cartwright's co-worker, R. D. Harris, found eight nests of Baird's sparrow in Manitoba in 1931, one nest of which contained a cowbird egg in addition to 3 of the sparrows. On July 14, Harris, watching another nest from a blind, saw a female cowbird approach the nest at 4:50 p.m. It inspected the blind but came within only two feet of the nest, which held young of the sparrow. The female Baird's sparrow returned and fed its young; then it saw and drove away the cowbird, after which it returned and began to brood the chicks.

LeConte's Sparrow

Passerherbulus caudacutus (Latham)

LeConte's sparrow is known to be parasitized by the brown-headed cowbird in Alberta, Saskatchewan, and Minnesota. Although the

actual records are still few in number, the fact appears that in suitable localities this bird may be a fairly common victim. In the Red River valley, Kittam County, Minnesota, P. B. Peabody (1901, pp. 131–132) found 14 nests, of which 4 were parasitized; 3 of them contained a single cowbird egg apiece in addition to eggs of the host, and 1 held a half-grown cowbird and 2 addled eggs of the sparrow. In the National Museum of Canada there is a parasitized set of eggs of this sparrow taken at Crane Lake, Saskatchewan, in 1895 by Wm. Spreadborough. Many years later Ferry (1910, pp. 199–200) also found that LeConte's sparrow was parasitized in Saskatchewan, and A. D. Henderson informed me that he has noted this in Alberta as well. Two races of the parasite are involved in these records, *ater* in Minnesota, and *artemisiae* in Saskatchewan and Alberta.

Henslow's Sparrow

Passerherbulus henslowii (Audubon)

Henslow's sparrow is a bird of which relatively little is known as far as its relations with the brown-headed cowbird are concerned. Only a few records have come to my attention. Hathaway (1913, p. 555) found a parasitized nest in Rhode Island on May 28, 1911. E. J. Court informed me that, out of 7 nests found in southern Maryland in 1932, 2 contained eggs of the cowbird, and that, out of about 15 nests found in previous years, several had been victimized. He considered Henslow's sparrow a locally common host. The late J. P. Norris wrote me that he had a set with a cowbird's egg, collected by Court in Maryland on May 28, 1917. This probably is one of the "several" referred to by Court. Stewart and Robbins (1958, p. 329) mentioned that they had learned of five cases of cowbird parasitism on this sparrow in Maryland. These five are probably also among those found by Mr. Court. Hicks (1934, pp. 385–386) noted a parasitized nest in Franklin County, Ohio. In Michigan, Olsen (1931, p. 482) reported a parasitized nest found by Walkinshaw near Battle Creek. Neither Hyde (1939) nor Sutton (1959, p. 150) found any evidence of cowbird parasitism on Henslow's sparrow in their studies in Michigan, which suggests that there this bird is only an occasional victim of the cowbird. At Hegewisch, Illinois, on June 19, 1932, G. J. Suthard collected a parasitized set of this sparrow's eggs.

The Michigan, Illinois, and Ohio records refer to the western, typical race of the sparrow, while the Rhode Island and Maryland instances are of the eastern race, *susurrans*. The cowbird in all cases is typical *ater*.

In spite of Court's experience in Maryland, it is not possible, except locally, to consider Henslow's sparrow as a frequent host of the parasite. Because of the relative scarcity and rather "spotty" local distribution

of the sparrow and the general abundance of the cowbird, it appears that the former is less important in the economy of the parasite than the latter is in that of the host.

Sharp-tailed Sparrow

Ammospiza caudacuta (Gmelin)

The race *nelsoni* of this sparrow is included in the present survey on the following basis. Many years ago the late P. B. Peabody wrote me that he remembered very clearly that one of his associates once found a cowbird egg in a nest of Nelson's sharp-tailed sparrow. Peabody had no way of getting the exact data on this occurrence. No one else since has reported a case of cowbird parasitism on this species. It would seem, from the fact that the sharp-tail is a marsh bird, that probably it is usually unmolested by the parasite.

Seaside Sparrow

Ammospiza maritima (Wilson)

The seaside sparrow is an unusual and rarely imposed upon victim of the brown-headed cowbird. The latter ordinarily does not inhabit brackish or salt water marshes, where this sparrow lives, and, as a result, it rarely would have a chance to parasitize the bird. There is only a single record for this sparrow (nominate race). Bagg and Eliot (1937, p. 634, ftn.) stated that the seaside sparrow was recorded as a fosterer of the cowbird at Martha's Vineyard by Mrs. Seth Wakeman. In response to my inquiry, Mrs. Wakeman informed me that the record referred to a fledged cowbird being fed and attended by a seaside sparrow. No young sparrows were observed with them.

Vesper Sparrow

Pooecetes gramineus (Gmelin)

The vesper sparrow is a fairly frequent victim of the brown-headed cowbird. About 70 records have been noted, involving two races of the sparrow, *gramineus* and *confinis*, and all three races of the cowbird. These records come from the following areas: Alberta, British Columbia, Quebec, and Saskatchewan in Canada; Colorado, the District of Columbia, Idaho, Illinois, Indiana, Iowa, Kentucky, Maryland, Michigan, Minnesota, Montana, Nebraska, New York, Ohio, Texas, Washington, and Wyoming in the United States. The race *gramineus* is parasitized by *ater; confinis*, by *artemisiae* and *obscurus*. In no locale is the vesper sparrow one of the commonest fosterers although Eaton (1914, p. 227) has listed it as such in New York. In Ohio, Hicks (1934) found 112 nests, of which 9 were parasitized; in southern Quebec, Terrill (1961, p. 10) found 74 nests, of which 3 had cowbird eggs. There is no need to repeat here the various records of geo-

graphic interest since they are given in my previous accounts (1929, pp. 217–218; 1934, p. 111).

The vesper sparrow has been known to rear the young of the parasite to the fledging stage.

Lark Sparrow

Chondestes grammacus (Say)

The lark sparrow is a relatively uncommon host of the brown-headed cowbird. Thirty records have been noted, involving all three races of the cowbird and two of the sparrow, *grammacus* and *strigatus*. The typical race, *grammacus*, is known to be parasitized by *ater* and *artemisiae;* the race *strigatus* is molested by *ater*, *artemisiae*, and *obscurus*. The records are distributed among the following states: California, Iowa, Kansas, Louisiana, Minnesota, Montana, Nebraska, North Dakota, Oklahoma, South Dakota, and Texas.

In his study of the lark sparrow in the upper Ohio valley, Brooks (1938b, p. 197) noted that the comparatively open nests of this species seemed well suited for the cowbird's requirements; he concluded that, in some areas, there must be a severe loss in numbers of the sparrow because of the activities of the cowbird. I have failed to detect evidence for a marked effect anywhere, and Brooks did not supply it for the region he studied. In Kansas, R. F. Johnston (in litt.) informed me of 6 parasitized nests out of a total of 22 found—an incidence of parasitism of about 25 percent.

Rufous-winged Sparrow

Aimophila carpalis (Coues)

The rufous-winged sparrow is a poorly known bird and the fact that little is on record concerning its relations with the brown-headed cowbird is not surprising. So little information exists that it all may be repeated here. Henshaw (1875, p. 292) wrote that "its nest appears to be the one most favored by the Dwarf Cow Bunting . . . as the recipient of its eggs." Bendire (1895, p. 292) made a similar statement, possibly based on the earlier one by Henshaw. In the U.S. National Museum were two sets of *Aimophila carpalis* eggs, each with a cowbird egg, reported to have been collected by Bendire, but they no longer can be located. They may have been the actual basis for Bendire's statement. A third set in the U.S. National Museum, also with a cowbird egg, was collected by H. P. Attwater at San Antonio, Texas, on June 5, 1899.

Davie (1889, p. 119), commenting on Bendire's experiences with this sparrow, wrote that "about one half of the nests found contained one or more eggs of the Dwarf Cowbird." Unfortunately, no indication is given as to the total number of nests found. J. T. Marshall, Jr. (in litt.), informed me that, in the mesquite woods of the San Xavier

Reservation, ten miles south of Tucson, Arizona, he found two parasitized nests, and that, in the University of Arizona collection, there is still a third such case, collected in the same area by P. J. Gould.

Bachman's Sparrow

Aimophila aestivalis (Lichtenstein)

This is an uncommonly victimized sparrow; only the following few records have been noted.

E. S. Woodruff (1907, p. 349) found a nest in southern Missouri on May 27, 1907, containing 2 sparrow and 3 cowbird eggs. This record relates to the race *A.a. illinoensis* of the sparrow.

Near Bardstown, Kentucky, Blincoe (1921, p. 100) on May 2 found a nest which at the time contained 1 sparrow egg. The next day the nest held 1 cowbird and 2 sparrow eggs; two days later all the eggs had disappeared, apparently having been removed by some predator. In a later paper the same author (1925, p. 412), discussing the cowbird at Bardstown, states that its eggs were found in nests of Bachman's sparrow and the indigo bunting. It is not clear whether or not Blincoe had seen additional instances of cowbird parasitism on Bachman's sparrow in the four years between the two reports.

Brooks (1938a, p. 100) reported a nest with 3 eggs of the sparrow and 1 of the cowbird at French Creek, West Virginia.

The Kentucky and West Virginia records refer to the race *A.a. bachmani* of the host. In all the above cases the nominate race of the parasite is involved.

Cassin's Sparrow

Aimophila cassinii (Woodhouse)

Cassin's sparrow appears to be an infrequent victim of the brown-headed cowbird. The known records are few enough to be listed here.

R. W. Quillen wrote me that at San Antonio, Texas, Cassin's sparrow rarely was bothered by the parasite, probably because the former concealed its nests so well. This, however, might explain why the nests were not found more often by human eyes than by the cowbird. Quillen found only three parasitized nests. The late J. H. Bowles wrote me that he had in his collection a similar set from San Antonio; the U.S. National Museum has two more sets from the same place, collected by H. P. Attwater. Finally, E. J. Court informed me that he also found this sparrow to be victimized near San Antonio. Nyc (in litt.) informed me that he collected a parasitized set of eggs near Loma Alta Lake, nine miles north of Brownsville, Texas, on June 21, 1943. In the files of the U.S. Fish and Wildlife Service there is the record of a parasitized nest found 30 miles south of Vernon, Texas, on May 2, 1930, by R. L. More. All of these records refer to the small

race of the cowbird, *M.a. obscurus*. In McLennon County, Texas, Strecker (1927, p. 47) found this sparrow to be a host of the eastern cowbird, *M.a. ater*.

Black-throated Sparrow

Amphispiza bilineata (Cassin)

The black-throated sparrow has been recorded only a few times as a victim of the brown-headed cowbird. Quillin and Holleman (1918, p. 42) found it parasitized in Bexar County, Texas, where they considered the bird to be a common victim. Merrill (1878, p. 130) noted it as a cowbird host at Brownsville, Texas. Many years later, I (1925, p. 551) also found it to be imposed upon there by the parasite. In the same area I was told by the late R. D. Camp that this sparrow was the commonest victim of the cowbird early in the season before many other birds began to nest. Another record from Brownsville, a set of 4 eggs of the sparrow and 2 of the dwarf cowbird, taken on June 16, 1913, is now in the collections of the Western Foundation of Vertebrate Zoology. In the U.S. National Museum there is a parasitized set of eggs taken at Eagle Pass, Texas, on June 3, 1902, by Nelson and Goldman. F. C. Nyc, Jr., (in litt.) found another parasitized nest east of Laredo, Texas, on June 11, 1942, and still another near the new dam on North Concho River, Tom Greene County, Texas, on June 11, 1953. All but the last of the Texas observations refer to the nominate race of the sparrow, *A.b. bilineata;* the latter report involves the race *A.b. opuntia*. At Tucson, Arizona, Scott (1887, p. 22) found eggs of the cowbird in nests of the western race, *A.b. deserticola*, and Bendire (1895, p. 443) also reported a parasitized nest in the same place.

Sage Sparrow

Amphispiza belli (Cassin)

The sage sparrow is a very uncommon victim of the brown-headed cowbird. Only a single record has come to my notice. In Fremont County, Idaho, Rust (1917, pp. 38–39) found a nest of this sparrow, race *A.b. nevadensis*, with 1 egg of the sparrow and 2 of the cowbird, race *M.a. artemisiae*.

White-winged Junco

Junco aikeni Ridgway

The white-winged junco was found to be a victim of the brown-headed cowbird, race *M.a. artemisiae*, in southeastern Montana. A. H. Miller (1948, p. 92) discovered two parasitized nests in the open pine woods of Powder River County, near Otter, in late June, 1947. One of the nests contained 1 egg and one young each of the host and the parasite; the other held 2 junco eggs and two young cowbirds. No other instances of cowbird parasitism on this bird have been noted.

Slate-colored Junco

Junco hyemalis (Linnaeus)

The slate-colored junco is an infrequently reported host; probably it is molested very slightly by the brown-headed cowbird. Eighteen instances have come to my attention. Three races have been recorded as victims: *cismontanus* in British Columbia; *carolinensis* in Virginia and West Virginia; *hyemalis* in Alberta, Saskatchewan, Ontario, Quebec, Nova Scotia, New York, Pennsylvania, and Ohio. These records involve two races of the parasite: *artemisiae* from Saskatchewan to British Columbia and *ater* in all the other areas. Both *cismontanus* and *hyemalis* have been known to rear young cowbirds.

In the Peace River District of British Columbia, Cowan (1939, p. 59) found that no fewer than four out of five junco nests which were observed were parasitized—evidence which suggests that in this region the bird is a commoner host than it has been found to be elsewhere. The Nova Scotia record is of interest as a far northeastern report. Mills (1957, pp. 25–27) noted that E. C. Allen found a fledgling cowbird attended and fed by juncos near Halifax, Nova Scotia, on July 17, 1933.

Terrill (1961, p. 10) made one observation which may imply a greater frequency of parasitism than the actual records have indicated. He found the junco to be a "very close sitter . . . not readily flushed from its well-concealed nest, so that few nests are found. . . ."

Oregon Junco

Junco oreganus (Townsend)

This junco has been recorded as a cowbird victim only a few times to my knowledge. In British Columbia, Cowan (1939, p. 59) found a parasitized nest in the Peace River district, and Schultz (1958, p. 435) reports that Davidson saw a young cowbird of the northwestern race, *M.a. artemisiae*, attended by Oregon juncos at Victoria, British Columbia. Still another report from that province, sent to me from the files of the British Columbia Nest Records Scheme at the University of British Columbia, concerns a nest with 4 eggs of the junco and 1 of the cowbird, found 35 miles south of Vernon, Okanagan Lake, June 17, 1959. The junco breeding in British Columbia is of the race *J.o. montanus*. At Berkeley, California, Johnston (1960, p. 137) observed a fledgling cowbird being attended and fed repeatedly by a female Oregon junco (race *pinosus*).

Chipping Sparrow

Spizella passerina (Bechstein)

The chipping sparrow is one of the commonest victims of the brown-headed cowbird. Over 600 records have been noted from

Alberta, British Columbia, New Brunswick, Ontario, Quebec, and Saskatchewan in Canada to the following of the United States: Arkansas, California, Colorado, Connecticut, Delaware, the District of Columbia, Illinois, Indiana, Iowa, Kansas, Kentucky, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Montana, Nebraska, New Jersey, New Mexico, New York, North Dakota, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Dakota, Tennessee, Texas, Virginia, Washington, West Virginia, and Wisconsin.

Three races of the sparrow are involved—*passerina, arizonae, boreophila*—plus all three races of the cowbird. Typical *ater* is known to parasitize *passerina* and *arizonae; artemisiae* is a parasite on *boreophila; obscurus* molests *arizonae*. Strangely, this last combination has been recorded but once, to my knowledge; a parasitized nest was found by Talmadge (1948, p. 273) at Hooper, Humboldt County, California, in June, 1948. To the recently described and officially recognized race *boreophila* should be referred the records formerly assigned to *arizonae* from Alberta, British Columbia, Saskatchewan, and the recent records published by King (1954, pp. 150–154) from Washington.

Not only is the chipping sparrow a very frequent victim—in the total number of known instances of cowbird parasitism—but it seems to be one of the main fosterers in almost every locality. In Ohio, Hicks (1934) found 115 nests of this bird, of which 60, or more than half, were parasitized. In Maryland, Stewart and Robbins (1958, p. 329) listed 18 records. In southern Quebec, Terrill (1961, p. 10) reported cowbird eggs in 16 out of 138 nests.

In my own field studies in central New York, over a dozen cases were observed. The percentage of parasitized nests of this species in that region was not as high as it was for some other birds, such as the phoebe, the red-eyed vireo, and the redstart; judging solely from my own local records, the percentage was about 15. This agrees roughly with Terrill's experience in Quebec but falls far short of Hicks's Ohio data. A surprisingly low incidence of parasitism was reported in Michigan by Walkinshaw (1949, pp. 193–205), who found that only 3 nests had been molested out of a total of 66 observed nests—less than five percent. An even lower degree of parasitism was reported in an adjacent area by Sutton (1960, p. 50). In the Edwin S. George Reserve of southeastern Michigan, he found only a single parasitized nest out of 38 observed. Sutton suggested that, since most chipping sparrow nests in that area were well hidden in the dense foliage of red cedars, such a phenomenon might be a factor in reducing the incidence of parasitism.

Not only is this sparrow a frequent victim, but it seems to be uniformly tolerant of the parasitic eggs; it has been known, on many

occasions, to rear the alien young. Nuttall (1840, p. 105) recorded watching a chipping sparrow remove its dead young from a nest which contained a healthy young cowbird. I know of no case of a chipping sparrow attempting to bury a cowbird egg under a new nest-lining, and I am not aware of any instances of nest desertion which could be ascribed to the presence of cowbird eggs. No one yet has made a statistical survey of nesting success in the chipping sparrow, a survey against which to appraise the effect of cowbird parasitism, as Hofslund has done with the yellowthroat or Nice with the song sparrow.

Clay-colored Sparrow

Spizella pallida (Swainson)

The clay-colored sparrow is a frequent victim of the brown-headed cowbird in Alberta. The late William Rowan told me that he had collected a series of nearly 20 parasitized sets of eggs near Edmonton. Rowan and T. E. Randall considered the clay-colored sparrow the commonest victim in Alberta.

Apart from this one area, the sparrow also has been found to be imposed upon by the parasite in British Columbia (two records, now in the collections of the Carnegie Museum), Saskatchewan, Montana, North Dakota, Minnesota, and Wisconsin. The North Dakota record, previously unpublished, consists of a set of 4 eggs of the sparrow with 1 of the cowbird, taken at Stump Lake on June 1, 1901, by A. C. Bent and now in the U.S. National Museum.

Near Kindersley, Saskatchewan, Fox (1961, p. 223) studied nine nests of this sparrow in one season. Of these, eight were parasitized by the brown-headed cowbird. In six of the eight, the parasitic eggs were laid before the host had begun to incubate, but in one nest the cowbird egg was deposited after the four young sparrows had hatched. Three of the nests were deserted after they had been parasitized. In none of the eight nests did any of the cowbird eggs hatch. No clay-colored sparrows hatched in any of the nests which had been parasitized by the cowbird before the host eggs hatched.

The clay-colored sparrow has been known to rear the young parasite (Raine, 1894, p. 120; Sparkes, 1952).

All in all, some 50 records of parasitism have been noted. They involve two races of the brown-headed cowbird; typical *ater* in Wisconsin and Minnesota; *artemisiae* westward from North Dakota and Saskatchewan.

Brewer's Sparrow

Spizella breweri Cassin

Brewer's sparrow is a poorly known victim of the brown-headed cowbird. It has been recorded in this capacity only in Wyoming

and New Mexico. No new information has been acquired since my first (1929, p. 223) account, which may be summarized as follows.

Jensen (1923, p. 461) wrote that he had found cowbird eggs in nests of this sparrow in northern Santa Fé County, New Mexico, but he gave no details. What may be one of Jensen's records is a parasitized clutch of eggs, taken on June 7, 1919, and now in the collections of the Western Foundation of Vertebrate Zoology. In the files of the U.S. Fish and Wildlife Service there is a field note by Merritt Cary from the Upper Green River Valley of Wyoming; the note reports a recently fledged cowbird attended and fed by Brewer's sparrow at Cora, Wyoming, on August 8. Another field note, by H. E. Anthony from the same area and with the same date, probably is based on the identical case.

The records refer to the typical race of the sparrow, to the northwestern race, *artemisiae*, of the cowbird in Wyoming, and to the nominate race, *ater*, in New Mexico.

Field Sparrow

Spizella pusilla (Wilson)

The field sparrow is a frequent victim of the brown-headed cowbird. Over 125 records have been noted, distributed from Quebec in Canada to the following of the United States: Connecticut, Illinois, Indiana, Iowa, Kansas, Maryland, Massachusetts, Michigan, Missouri, New Jersey, New York, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Dakota, Tennessee, Virginia, and Wisconsin.

Almost all of the records refer to the typical, eastern race of the field sparrow. The lack of additional data for the western race, *arenacea*, probably reflects a lack of human observation rather than an actual difference in the lives of the sparrow and the cowbird in that area from western Oklahoma to the Dakotas and Montana.

In Ohio, Hicks (1934) found 159 nests of this sparrow, of which 51 contained eggs or young of the cowbird—a notably high percentage of parasitism. In Iowa, Anderson (1907, pp. 297–300) considered the field sparrow one of the two most parasitized birds; a similar conclusion was made in Ohio by Dawson (1903, p. 15).

A recent study by Walkinshaw (1949) in Calhoun County, Michigan, has given new insight into the host-parasite relations of the field sparrow and the brown-headed cowbird. Eggs of the latter (apparently from one individual!) were laid in 20 field sparrow nests, of which 15 were deserted when the parasite laid its own and removed a host egg. At least 17 field sparrow eggs and four young disappeared from 16 nests, presumably removed by the cowbird. It follows from this that, at times and in places such as Calhoun County, the cowbird may be a very serious factor in the welfare of the field sparrow. How-

ever, the frequency with which this sparrow is molested must vary from time to time; in an earlier study, the same observer (Walkinshaw, 1936) noted that, out of 70 nests of the field sparrow, only four contained eggs of the cowbird, whereas, in only 12 nests found in 1935, four were parasitized. All but one of the parasitized nests were deserted by the sparrows.

In the nearby Edwin S. George Reserve, Sutton (1960, pp. 57–58) found 59 nests of the field sparrow, of which 11 were parasitized. However, he noted that he had never seen a fledgling cowbird attended by field sparrows, and he concluded that, although parasitism apparently cuts down sharply the percentage of nest-success for the host, it does so without producing any parasitic young. In Maryland and the District of Columbia, Stewart and Robbins (1958, pp. 329, 363) listed 11 cases of parasitism but they recorded data on some 265 field sparrow nests.

As many as 5 cowbird eggs have been reported from a single nest together with 2 of the field sparrow.

The field sparrow quite often is tolerant of the cowbird eggs and has been known on several occasions to rear the young parasites to the fledgling stage. Walkinshaw's data, noted above, seems to have involved an unusually intolerant group of birds.

Two records from South Dakota refer to the western race, *arenacea*, of the sparrow and to the race *artemisiae* of the cowbird. All the other records involve the nominate race of each bird.

Black-chinned Sparrow

Spizella atrogularis (Cabanis)

This little known bird has been recorded only twice as far as I know as a victim of the dwarf race of the brown-headed cowbird. In the files of the U.S. Fish and Wildlife Service there is a record by Stokely Ligon reporting a parasitized nest which was found 18 miles above Santa Rosa, New Mexico, on July 6, 1913. The sparrow there is the race *evura*. Bent (1958, p. 454) noted that Hanna collected two parasitized nests in San Bernardino County, California. The local race of the sparrow is *cana*.

White-crowned Sparrow

Zonotrichia leucophrys (Forster)

The white-crowned sparrow is imposed upon infrequently by the brown-headed cowbird. There are only a few records, which are outlined below. Rust (1917, pp. 37–39) found a nest with 4 eggs of the sparrow and 1 of the cowbird in Fremont County, Idaho. Two parasitized nests were found at Okotoks, southern Alberta, one by Lings (Friedmann, 1949, p. 161) on June 11, 1930, the other by

Beaurre on June 8, 1907. The latter set is now in the Royal Ontario Museum of Zoology at Toronto.

At Potsdam in northern New York, Kedney (1869, p. 550) found on May 15, 1868, the two-storied nest of a white-crowned sparrow containing the single egg of a cowbird under the second nest floor plus 2 more cowbird eggs and 3 sparrow eggs in the new nest above. These were being incubated by the sparrow when found; on blowing, they proved to be well advanced in incubation.

Barnes (1918, p. 109) recorded a set of white-crowned sparrow eggs with 1 of the cowbird, but, unfortunately, he gave neither date nor locality.

The Idaho and Alberta records relate to the race *oriantha* of the sparrow and *artemisiae* of the cowbird; the New York instance, to typical *leucophrys* and to typical *ater*.

White-throated Sparrow

Zonotrichia albicollis (Gmelin)

The white-throated sparrow is generally an infrequent host of the brown-headed cowbird, but in southern Quebec it appears to be a regular and not uncommon victim. In the course of nearly 60 years of field observation, Terrill (1961, p. 10) found the astonishing number of 507 nests of this sparrow within a limited area of southern Quebec; of these, 20, or 4 percent, had been parasitized by the cowbird. While the percentage of parasitism was relatively small, the total number of observed cases of parasitism is slightly more than all the other reported instances I have been able to gather. (During the same long period of years, Terrill found 481 nests of the song sparrow, of which 62, or 12.7 percent, contained eggs of the cowbird.) Of the 20 most frequently victimized host species in that area, only the goldfinch was less often victimized (7 nests, out of 318 examined, or 2.2 percent).

All in all, some 36 records have come to my notice. Apart from southern Quebec, the white-throated sparrow has been found to be victimized in Itaska County, Minnesota, in Michigan, by A. R. Cahn (1920, p. 116; 1918, p. 497), and in Wisconsin, by Robbins (1949). Rowan (1922, p. 229) found this sparrow rearing a young cowbird at Indian Bay, Manitoba. Snyder and Logier (1930, pp. 194–195) found a parasitized nest in York County, Ontario. Harrington and Beaupre collected other parasitized nests in Ontario, which are now in the Royal Ontario Museum. J. D. Carter (1906, p. 32) reported a nest in Monroe County, Pennsylvania. Hooper and Hooper (1954) noted a fledgling cowbird being fed by a white-throated sparrow in the Somme district, Saskatchewan. T. E. Ran-

dall and A. D. Henderson wrote me of at least seven parasitized nests in Alberta.

The records from Alberta, Saskatchewan, and Manitoba refer to the race *artemisiae* of the cowbird; the others, to *ater*.

Fox Sparrow

Passerella iliaca (Merrem)

The fox sparrow is an infrequent victim of the brown-headed cowbird. Only in one place has anyone considered it a common host; Saunders (1911, p. 40) wrote that in Gallatin County, Montana, "Mr. Thomas found the eggs and young quite commonly in the nests of the Slate-colored Sparrow." Ridgway (1887, p. 501) recorded a parasitized nest at Parley's Park, Wasatch Mountains, Utah, on June 23, 1869. The late J. H. Bowles wrote me years ago that a friend of his collected several sets of fox sparrow eggs with cowbird eggs near Spokane, Washington. Bendire (1889, p. 113) noted a cowbird's egg in a fox sparrow's nest at Palouse Falls, southeastern Washington, on June 18, 1878. Street (Houston and Street, 1959, p. 176) found another parasitized nest at Nipawin, Saskatchewan. J. B. Hurley (in litt.) found a nest with 2 eggs of the sparrow and 1 of the cowbird, five miles southeast of Sesters, Deschutes County, Oregon, on May 16, 1960. In the collections of the Santa Barbara Museum of Natural History there is a parasitized set of eggs collected on June 9, 1922, at Mammoth Lakes, Mono County, California.

These few records are all that I have noted. They refer to the northwestern race of the cowbird, *M.a. artemisiae*, and to the following races of the fox sparrow: *zaboria* in Saskatchewan; *olivacea* in Washington; *schistacea* in Gallatin County, Montana; *swarthi* in the Wasatch Mountains, Utah; *fulva* in Oregon; and *monoensis* in Mono County, California.

Lincoln's Sparrow

Melospiza lincolnii (Audubon)

This sparrow has been recorded as a cowbird victim only a small number of times. S. S. Stansell, A. D. Henderson, and T. E. Randall informed me independently of parasitized nests, six in number, which they had found in Alberta. Dr. Ian McTaggert Cowan wrote me of a parasitized nest found at Elk Island Park, Alberta, the notes on which are in the files of the University of British Columbia. The late J. H. Bowles wrote me that he had in his collection a parasitized set of eggs taken at Kalevala, Manitoba, on June 6, 1920. G. Bancroft informed me of set found in Monroe County in northern New York on June 1, 1903. Street (Houston and Street, 1959, p. 195) found a nest at Nipawin, Saskatchewan, on June 3, containing only

1 egg of the sparrow; two days later it held 2 sparrow eggs and 2 cowbird eggs; and two days later, again, it held 3 cowbird eggs, no sparrow eggs, and the shell of another cowbird egg outside but near the nest. The New York record refers to the eastern race of the cowbird, *M.a. ater*; the others, to *M.a. artemisiae*. All refer to the typical race of the sparrow.

Swamp Sparrow

Melospiza georgiana (Latham)

The swamp sparrow is generally an uncommon victim of the brown-headed cowbird. A number of authors have mentioned it as a host without giving any details. Bendire, Davie, and others of the old "egg collectors" have made such statements, but the actual records which have been found are relatively few. Although the cowbird frequents marshes during migration, it tends to leave marsh nests alone. At Ithaca, New York, where both the swamp sparrow and the cowbird are common, there were no records of parasitism on the species.

This sparrow has been found by Ferry (1910, pp. 199–200) to be a molothrine fosterer in Saskatchewan; in Alberta, by Stansell (in litt.); in Ontario, by several observers (eggs in museums of Toronto and Ottawa); in Minnesota, by Currier (1904, p. 37); in Wisconsin, by Gunderson (1948); and in Michigan, by Cook (1893, p. 88) and Berger (1951). There are other records, mostly of parasitized sets, the data of which are not available to me since they were in collections which have been dispersed. In Michigan, Berger (1951, p. 28) reported an unusual degree of parasitism on the swamp sparrow: he observed five nests, four of which had been victimized by the cowbird.

Although the swamp sparrow appears to be a rather uncommon victim of the brown-headed cowbird in most areas where the two exist together, it has been found to be a frequent and submissive host in southern Quebec. Here, L. M. Terrill (1961, p. 10), between 1897 and 1956, found 322 nests of the swamp sparrow, of which 34, or roughly 10 percent, contained eggs of the cowbird. He wrote that the swamp sparrows in his area nested chiefly in sedgy tussocks among small willows in shallow water. Apparently this environment was more acceptable to the cowbirds than are the usual marshy areas.

The Alberta and Saskatchewan records refer to the race *ericrypta* of the sparrow and *artemisiae* of the cowbird; the Quebec, Minnesota, and Michigan records involve the nominate race of both host and parasite.

Song Sparrow

Melospiza melodia (Wilson)

The song sparrow is one of the most frequent, if not the most frequent, victim of the brown-headed cowbird. Since the former is

sympatric with the latter throughout the entire breeding range of the parasite, it is parasitized probably more often and over a greater area than any other bird. The total number of records is very great. After accumulating over 900, I stopped noting them except for records of special interest. The data came from every province of Canada and every state of the United States included in the breeding ranges of both birds. All three races of the parasite are involved, and no less than 17 races of the song sparrow: *melodia, atlantica, euphonia, juddi, montana, inexpectata, merrilli, fisherella, morphna, cleonensis, gouldii, samuelis, pusillula, heermanni, cooperi, fallax,* and *saltonis.* So far, none of the purely Mexican races have been reported as fosterers of the cowbird, but this fact is probably due more to a lack of human observation than to any actual immunity of the bird to cowbird parasitism.

There is no need to detail actual instances for the various races of the song sparrow since such cases already have been given in my earlier summaries (1929, pp. 225–226; 1934, pp. 113–114; 1938, p. 50; 1943, p. 356; 1949, pp. 161–162). However, a few additional records of infrequently reported races of the host species should be mentioned. Talmadge (1948, p. 273) found a nest of the subspecies *cleonensis* with 3 eggs of the sparrow and 1 of the dwarf cowbird at Mad River Bar, Humboldt Co., California, in June, 1947. *M.m. fallax* was reported as a cowbird host in Wyoming by McCreary (1957, p. 94). *M.m. morphna* was seen feeding a fledgling cowbird at Comox, British Columbia, by W. R. Goodge and Z. M. Schultz (1956, p. 404). *M.m. saltonis* is represented by five parasitized sets of eggs, all from Yuma, Arizona, and now in the collections of the University of Arizona (J. T. Marshall, Jr., in litt.). For *M.m. samuelis,* two instances of cowbird parasitism (Johnston, 1956, p. 29; 1960, p. 138) are of interest as evidence of the cowbird's laying in nests within salt marsh vegetation. Johnston noted that, in the San Francisco Bay marshes, the song sparrows built their nests within lumps of pickleweed (*Salicornia ambigua*), cordgrass (*Spartina foliosa*), or gumplant (*Grindelia cuneifolia*). The two nests that had been parasitized were found in gumplant shrubs, which, of the three plants, is the most similar to the nonswamp vegetation of the cowbird's more usual habitat. For *M.m. inexpectata,* two additional instances of cowbird parasitism in the Vanderhoof region, British Columbia, were recorded by Munro (1949, p. 113).

In recent years, not only many hundreds of additional cases, but also much more quantitative data on the host-parasite relations have become available. Hicks (1934) found that 135 out of 398 nests (34 percent) of this sparrow were parasitized in Ohio. Nice (1937a, pp. 196–201; 1937b, p. 159), also in Ohio, reported that 98 out of

223 nests (43.9 percent) contained eggs or young of the cowbird (the annual percentage varied from 24.6 to 77.7 percent). Sixty-six unparasitized nests raised an average of 3.4 song sparrows whereas 28 successful but parasitized broods averaged only 2.4 song sparrows, indicating that each cowbird was reared at the expense of one song sparrow. In one instance Nice (1930) found that a pair of song sparrows raised a young cowbird together with five of their own young. Apparently here no loss of sparrows was involved. In another paper, Nice (1936) noted that, in all the song sparrow nests which she had watched during a period of five years, adult cowbirds removed 5.7 percent of the song sparrow eggs and nestling cowbirds crushed or starved 3.5 percent of the young sparrows. The cowbird eggs did not succeed as well as those of the host; only 30.7 percent of the former, but 35.8 percent of the latter, reached the fledging stage. In 1930–31 there was one female cowbird to about 11.5 pairs of suitable hosts, but in 1934–35 there was one to 8.6 pairs of suitable victims.

Of all song sparrow nests parasitized, Nice reported that 70 percent held a single cowbird egg each, 27 percent held 2 each, and 3 percent held 3 each. In the area of study—near Columbus, Ohio—the song sparrow was the most important host of the parasite. Norris (1947, p. 90) noted that 11 out of 27 nests (40.7 percent) in Pennsylvania were parasitized, and Berger (1951a, p. 30) recorded 37 out of 59 nests found in Michigan (62.7 percent). In the Detroit area, as reported by the Detroit Audubon Society (1956, p. 90), the average frequency of parasitism of the song sparrow was 40.1 percent of all the nests found: in 1950, 41 nests were found, of which 20, or 49 percent, were parasitized; in 1951, 18 nests were located, of which 8, or 44 percent, were parasitized; in 1954, 39 nests were found, of which 14, or 35.9 percent, contained eggs or young of the brown-headed cowbird. These figures are considerably below Berger's figures, which included the Ann Arbor section.

One is drawn toward attempting an over-all estimate of the frequency with which the song sparrow is victimized, but to do so with any feeling of accuracy is difficult because the incidence of parasitism appears to vary geographically (or, at least, the frequency with which it is reported varies). From this it follows that the over-all percentage depends on how many geographically different areal data are used in the estimation. For example, if we put together, as a geographical unit, a group of studies made in Pennsylvania (Norris, 1947), Ohio (Hicks, 1934; Nice, 1937), and Michigan (Berger, 1951; plus Detroit Audubon Survey Records), we come up with a total of 323 parasitized nests out of 804 nests observed, or a little over 40 percent. On the other hand, in southern Quebec (Terrill, 1961, p. 11), out of 486 nests observed, only 62, or 12.7

percent, were parasitized. If we put all these studies together, we get a total of 382 out of 1,285 nests victimized, or 29 percent. This figure becomes yet smaller when we attempt to include data from other parts of the continent.

An interesting case, reported by Berger (1951b), involves 10 consecutive nests of a single color-banded song sparrow over a period of three seasons, from 1948 through 1950. In seven of these nests, 18 cowbird eggs were laid, plus at least 27 sparrow eggs. One cowbird and six sparrows were fledged from all 10 nests. In the summer of 1949, the sparrow had no fewer than five consecutive nests; and in 1950, four. It would seem that, if none of these nests had been interfered with, there would not have been sufficient time for four or five in one season. This, therefore, must be kept in mind when attempting to evaluate the damage to the host which is done by the cowbird. It appears that one of the effects of parasitism may be to increase the "nesting potential" of the host. (See also the discussion of Walkinshaw's field sparrow data, p. 164.)

As many as 7 cowbird eggs have been found in a single nest of this sparrow; there are numerous records of 3, 4, and 5 parasitic eggs to a nest. Occasionally, but not often, song sparrows may partly bury cowbird eggs by building a new nest lining over them—if the alien egg is laid before any eggs of the host.

Salmon (1933, p. 100) has reported seeing a song sparrow feeding three fledgling cowbirds; no young sparrows were mentioned. Lees (1939, p. 121) recorded that near Wetaskiwin, Alberta, he watched a song sparrow feeding no less than five young cowbirds. This must be a record of fledgling success for any host species.

McCown's Longspur

Rhynchophanes mccownii (Lawrence)

McCown's longspur is not well known as a host of the brown-headed cowbird since relatively few observers have studied it. Raine (1894, p. 120) listed it as a cowbird victim (race *M.a. artemisiae*) as did Bendire also, the following year, possibly on the basis of Raine's statement. Many years later, about 1921, Alfred Eastgate informed me that he had found this longspur to be a victim in North Dakota. Later still, the late L. B. Bishop wrote me that, out of three nests of this species found near Cando, North Dakota, two contained eggs of the cowbird in addition to those of the longspur. S. J. Darcus sent me data on one record from Saskatchewan—a parasitized nest he found at Cypress Hill on June 7, 1920. No other records have come to my attention. In his study of McCown's longspur, Mickey (1943) found no evidence of cowbird parasitism near Laramie, Wyoming, nor did DuBois (1935, 1937) in Montana.

Chestnut-collared Longspur

Calcarius ornatus (Townsend)

This longspur is probably a not uncommon local victim of the northwestern race of the brown-headed cowbird. The paucity of records seems to be due to a scarcity of observers in the breeding range of the host. In the country around Grand Forks, North Dakota, R. P. Currie (1892, p. 243) observed that the nests of the chestnut-collared longspur frequently were victimized; 1, 2, or 3 cowbird eggs were discovered in various nests. Raine (1894, p. 120) wrote that he found this species to be victimized, and Alfred Eastgate informed me that he had also found this to be the case in North Dakota. There are three parasitized sets of eggs collected by Elmer T. Judd from Townes County, North Dakota, in the U.S. National Museum. In the collections of the Western Foundation of Vertebrate Zoology there is another set from Townes County, taken on May 27, 1894.

I am informed by Professor R. E. Ware that, among other specimens in the Harllee collection at Clemson College, there is a parasitized set of eggs of this longspur, taken on June 19, 1933, at Deering, North Dakota, by George C. Whithey. This is one of the very few recent records of the bird as a cowbird fosterer, but, as noted above, the chestnut-collared longspur had been reported as a frequent host at Grand Forks, North Dakota in the 1890's. North Dakota is the only area where this longspur has been observed repeatedly as a cowbird victim.

Mr. S. J. Darcus wrote to me that he had found a parasitized nest at Cypress Hills, Saskatchewan, on June 1, 1920.

Bronzed Cowbird

Tangavius aeneus (Wagler)

Discussion

The following catalog of the known hosts of the bronzed cowbird includes 52 species, or, with subspecies, 64 forms of birds. They comprise 12 families, one of which, the pigeons, can only be looked upon as accidental, as these birds are quite unsuited for the role of potential fosterers. One other family, the cotingas, is known as a host from a single instance; the thrushes are represented by a single species, with two records of parasitism; the jays are known from three instances involving a single species; the warblers, with three instances involving 2 species; and the vireos are represented by 2 species, one with a single record of parasitism and the other with five such records. The remaining 6 families are represented as follows: flycatchers—4 species with 7 records; wrens—5 species with 1 record apiece; thrashers—4 species with 7+ records; tanagers—3 species with 5 records; orioles and blackbirds—11 species with 84 records; finches—16 species with 51 records.

Since the bulk of all the cases recorded are in the last two families, it becomes increasingly clear that these two groups comprise the primary hosts of the bronzed cowbird. This parasite is, thus, more selective, or more restricted, in its choice of fosterers than are the brown-headed and the shiny cowbirds. The infrequent use of vireos and wood warblers and the relative scarcity of records of tyrant flycatchers are striking and significant differences from the situation revealed in a survey of the frequent hosts of the brown-headed cowbird.

As I described in my first account (1929, pp. 328–334) of the bronzed cowbird's fosterers, its relatively restricted range of host choice becomes meaningful when we remember that its nearest relative (and possible ancestral stock) is the screaming cowbird, *Molothrus rufo-axillaris*. That species is parasitic entirely on its very close ancestral relative, the bay-winged cowbird, *M. badius*. From *M. rufo-axillaris*, or the stock of which it is the extant representative, two lines have diverged, one leading to a wide host-tolerant group of parasites, *M. bonariensis* and *M. ater*, and one that retained more of the restricted host relationships of its ancestor, the present species *T. aeneus*. Not having any self-breeding immediate relatives to parasitize, as does *M. rufo-axillaris*, the bronzed cowbird apparently

centered its attentions on the nests of an allied group, the hangnests of the genus *Icterus*. It has gradually widened its scope of parasitism to include many other birds, but even today a large percentage of its recorded eggs and young are to be found in the nests or in the care of species of *Icterus* and related birds. The process has gone far enough to make some of the finches equally acceptable in this respect, as is evidenced by Dickerman's observations on the degree of parasitism inflicted on the song sparrow in Chapultepec Park, Mexico City, and Rowley's report on the frequency with which the rusty-crowned sparrow is victimized in Morelos—as high a local frequency as has been noted for any species of host.

The data in my 1929 report (p. 328) referred to 76 victimized nests, of which no fewer than 51 belonged to 4 species of *Icterus*. The present material is more than twice as great—186 individual records plus an indefinite number that can only be inferred from the use of adjectives such as "common" or "frequent" inserted before the word "host" by the describers. Of the 186, 84 refer to the genus *Icterus*, 9 species of which are now included. In addition, it may be noted that all the hosts described loosely in print or in correspondence as "common" or "frequent" were species of *Icterus*. The percentage of the total that concerns species of *Icterus* is less now than in the 1929 material, about 45 percent instead of two-thirds. This drop is in part a contrived result, due to the fact that many recent observations on Icterine hosts have not been published because of their repetitive nature while every additional instance of a less frequent host is more apt to be put on record.

In the present catalog the hosts are discussed as species. However, to make the data as readily usable as possible, I have first tabulated them by subspecies both of the hosts and of the parasite. In this table no column has been left for the Colombian race of the bronzed cowbird, *T.a. armenti*, for the reason that nothing is known of its hosts. In fact, it is only an assumption, although a likely one, that it is parasitic in its breeding. It will be obvious at a glance that very little is known of the breeding habits of the small southwest Mexican race *T.a. assimilis*. The fact that none of its 4 known hosts is a species of *Icterus* should not be assumed to be meaningful; this is probably a matter of insufficient field observation in its range. The greater number of hosts recorded for *T.a. aeneus* than for *T.a. milleri* is, again, merely a reflection of differential amounts of study and collecting in their respective habitats.

Approximately one-third of all the victims have been found to rear the young bronzed cowbirds (at least as far as the fairly well-feathered nestling stage). For many of the others, the absence of such records

means only that the observers had no opportunity of revisiting the nests later or else that they collected the eggs and thereby put to an end their chances of success. Aside from the two species of doves, all the hosts seem potentially able to incubate, hatch, feed, and give proper care to the young of the parasite.

Hosts of the Bronzed Cowbird

Summary

Host	*Tangavius aeneus*			Host	*Tangavius aeneus*		
	aeneus	*milleri*	*assimilis*		*aeneus*	*milleri*	*assimilis*
Zenaida asiatica mearnsi		x		Icterus gularis gularis	x		
Columbigallina passerina pallescens	x			" " tamaulipensis	x		
Platypsaris aglaiae albiventris		x		" cucullatus nelsoni*		x	
Tyrannus melancholicus couchii	x			" " sennetti*	x		
" " occidentalis		x		" pustulatus microstictus		x	
Tyrannus melancholicus chloronotus	x			" " alticola	x		
Muscivora forficata	x			" " pustulatus	x		
Myiozetetes similis primulus		x		" bullockii bullockii*	x		
Pitangus sulphuratus derbianus		x		Piranga flava hepatica	x	x	
Cyanocorax yncas vivida	x			" rubra cooperi*		x	
" " luxuosa*			x	" erythrocephala candida*		x	
Thryothorus modestus pullus*	x			Richmondena cardinalis magnirostris*	x		
" sinaloa cinereus		x		Richmondena cardinalis canicaudus	x		
" pleurostictus nisorius	x			Pheucticus melanocephalus melanocephalus		x	
" felix pallidus		x		Guiraca caerulea eurhyncha			x
Thryomanes bewickii cryptus	x			" " caerulea	x		
Mimus polyglottos leucopterus	x			Passerina ciris pallidior	x		
" gilvus gracilis	x			Amaurospisa concolor relicta	x		
Toxostoma longirostre sennetti*	x			Atlapetes gutturalis parvirostris	x		
" lecontei lecontei		x		Arremonops rufivirgata rufivirgata	x		
Catharus aurantiirostris costaricensis*	x			Arremonops conirostris richmondi	x		
Catharus aurantiirostris clarus	x			Pipilo erythrophthalmus repetens*	x		
Vireo solitarius plumbeus		x		Pipilo fuscus mesoleucus*		x	
" flavoviridis flavoviridis*	x			" " fuscus	x		
Icteria virens auricollis	x	x		" albicollis albicollis			x
Basileuterus rufifrons dugesi	x			Melozone kieneri rubricatum	x		
Cassiculus melanicterus		x	x	Aimophila humeralis	x		
Agelaius phoeniceus megapotamus	x			" ruficauda acuminata	x		
Icterus spurius	x	x		" rufescens pyrgitoides	x		
" fuertesi*	x			" " rufescens	x		
" parisorum		x		Melospiza melodia mexicana*	x		
" graduacauda audubonii*	x	x					
" pectoralis pectoralis	x						

* Have been known to rear young bronzed cowbirds.

White-winged Dove

Zenaida asiatica (Linnaeus)

In an earlier paper (1933, p. 189) I noted a single record of this dove as a cowbird victim. Since then no other has come to my attention. The unique instance was observed by J. T. Wright at Guirocoba, Sonora, during late May, 1931. The dove involved was of the race *Z.a. mearnsi;* the parasite, *T.a. milleri.*

Ground Dove

Columbigallina passerina (Linnaeus)

The ground dove is a purely accidental victim. There is but a single record, which I have seen in the sale catalog of an egg collection; the latter was offered in 1929 to the late Senator F. C. Walcott, who showed the record to me. As the eggs were said to have been taken in southern Arizona, the parasite must have been of the race *T.a. milleri;* the host, of the race *C.p. pallescens.*

Rose-throated Becard

Platypsaris aglaiae (Lafresnaye)

A single instance of the rose-throated becard as a victim of the bronzed cowbird has come to my notice. In his price list of eggs for sale, Schlüter (1899) mentioned a set of eggs of this bird (under the name *Hadrostomus albiventris*) which included an egg of *Tangavius a. aeneus* (probably now to be interpreted as *T.a. milleri*).

Tropical Kingbird

Tyrannus melancholicus Vieillot

This kingbird was found to have been parasitized by the bronzed cowbird four times to my knowledge, a fair degree of frequency for a bird as seldom studied as this. It happens that these records involve three different races of the host. A parasitized set taken at Brownsville, Texas, May 24, 1902, by F. B. Armstrong (the eggs are now in the A. E. Price collection, Grant Park, Illinois) is of the race *couchii;* at Refugio, Texas, T. C. Meitzen (in litt.) obtained another parasitized set of this same subspecies; a third set, found at Mazatlan, Sinaloa, June 14, 1882, by A. Forrer (the eggs are now in the collection of the Florida State Museum, Gainesville), is of the race *occidentalis;* and a fourth set, taken near San Antonio, Orange Walk, British Honduras, May 2, 1926, by G. D. Smooker (the eggs are now in the R. Kreuger collection, Helsinki, Finland), is of the subspecies *chloronotus.* The Sinaloa record involves the race *milleri* of the parasite, the other three refer to nominate *aeneus.*

Scissor-tailed Flycatcher

Muscivora forficata (Gmelin)

As far as I have been able to learn the scissor-tailed flycatcher has been recorded only twice as a host of the bronzed cowbird. Merrill (1877) wrote that a soldier at Fort Brown brought him a bronzed cowbird egg which the soldier said he had found in a scissor-tail's nest. A parasitized set taken in Lee County, Texas, May 20, 1887, now in the Chicago Natural History Museum, is the only other record. Both records refer to the nominate race of the cowbird.

Vermillion-crowned Flycatcher

Myiozetetes similis (Spix)

A set of 4 eggs of this flycatcher with 1 of the bronzed cowbird (race *milleri*), taken at Presidio, Sinaloa, Mexico, May 15, 1881, by A. Forrer (the set is now in the A. M. Ingersoll collection), is the only record for this bird as a host. The host subspecies here involved is *M.s. primulus*.

Kiskadee Flycatcher

Pitangus sulphuratus (Linnaeus)

Owen (1861, pp. 61–62) wrote that at San Geronimo, Guatemala, eggs of the bronzed cowbird (race *T.a. aeneus*) were found occasionally in the nests of this flycatcher. Salvin and Godman (1886, p. 452) list the kiskadee as a host, probably on the basis of Owen's statement. An indication of how little has been observed of this host-parasite situation may be seen in the fact that no further data have been placed on record in the century since Owen's observation. The Guatemalan race of the kisadee is *P.s. derbianus*.

Green Jay

Cyanocorax yncas (Boddaert)

Dr. Travis C. Meitzen (in litt.) collected two parasitized nests of the green jay, at Mante, Tamaulipas, one on May 28, 1948, and another on May 21, 1952. The first one contained 3 eggs of the host and 1 of the bronzed cowbird; the second one held 3 eggs of the jay and no less than 6 of the bronzed cowbird. It is very unusual to find so many eggs of the parasite in any one nest, but the record appears to be reliable.

Bent (1958, p. 462) notes that Skutch found a nest of the green jay near Matias Romero, in the Isthmus of Tehuantepec, Oaxaca, on July 8, 1934; the nest contained a young bronzed cowbird, almost ready to fledge, together with two young jays.

The Tamaulipas records refer to the race *vivida* of the jay and *aeneus* of the cowbird; the Oaxaca one involves the race *luxuosa* of the jay and *assimilis* of the parasite.

Plain Wren

Thryothorus modestus Cabanis

There is but a single record of this wren as a host of the bronzed cowbird. Stone (1932, p. 336) mentioned a fledged cowbird being fed and attended by a plain wren at Cantarranas, Honduras, August 5. The wren at that locality is of the race *T.m. pullus;* the parasite is nominate *aeneus.*

Sinaloa Wren

Thryothorus sinaloa (Baird)

Stager (1954, p. 30) found a nest of this wren (subspecies *cinereus*) near Naranjo, southwestern Chihuahua, on May 29, containing 2 eggs of the wren and 1 of the bronzed cowbird (subspecies *milleri*). This is the only instance to be recorded as yet.

Banded Wren

Thryothorus pleurostictus Sclater

At Canon de Lobos, Morelos, on July 19, 1960, J. Stuart Rowley (mss.) found a nest of this wren containing 2 eggs of the bronzed cowbird (nominate race) and none of the wren (*T.p. nisorius*). This is the only record known to me for this host.

Happy Wren

Thryothorus felix Sclater

A single record, without detailed data, is all I have seen of this wren as a host of the bronzed cowbird. A set of eggs of the race *T.f. pallidus* containing an egg of the parasite (race *T.a. milleri*) was listed in the catalog of an egg collection offered in 1929 to the late Senator F. C. Walcott, who showed the record to me.

Bewick's Wren

Thryomanes bewickii (Audubon)

There is still but the one record of this wren as a victim of the bronzed cowbird, a record which was included in my first list (1929, p. 334). On May 6, 1924, near Brownsville, Texas, the late A. H. Cordier found a nest of this wren (race *T.b. cryptus*) containing 3 eggs of the bronzed cowbird (race *T.a. aeneus*) and 1 of the wren. The female wren was sitting on the eggs at the time of observation. The next day all the eggs hatched, but two days later all were destroyed by a predator, probably a skunk.

Northern Mockingbird

Mimus polyglottos Linnaeus

This is a rarely victimized species. At Brownsville, Texas, I was told of a nest of this mockingbird with a very light, bluish-white,

unspotted egg in it, as well as 3 of the ordinary mockingbird eggs. When my informant was shown several assorted eggs, he picked out a bronzed cowbird's egg and said it was like the one he saw in the mockingbird's nest. Since then, no additional records have come to my attention. The mockingbird at Brownsville is of the race *M.p. leucopterus;* the cowbird is nominate *aeneus.*

Southern Mockingbird

Mimus gilvus (Vieillot)

On the basis of Owen's observations (1861, pp. 60–62) at San Geronimo, Guatemala, this bird is known as a host of the bronzed cowbird. Owens considered it to be a frequent victim and, in one nest, he noted as many as 5 eggs of the parasite together with 2 of the host. Salvin and Godman (1886, p. 452), on the basis of Owen's notes, merely listed this mockingbird as a cowbird host; they gave no additional data, and, indeed, since then no one else has done so.

The race of the mockingbird at San Geronimo is *M.g. gracilis;* that of the cowbird is *T.a. aeneus.*

Long-billed Thrasher

Toxostoma longirostre (Lafresnaye)

There are only a very few records of this thrasher as a host of the bronzed cowbird. In my first account (1929, p. 334), I listed two parasitized nests in Cameron County, Texas, both found by the late R. D. Camp. Since then, one additional case has been reported: Webster (1956, p. 396) saw a pair of long-billed thrashers feeding two newly fledged bronzed cowbirds at Olmito, Texas, on July 28. This is the first observation showing that this host may rear the parasitic young; the earlier records were only of observed eggs. The local race of the thrasher is *T.l. sennetti*; of the cowbird, *T.a. aeneus.*

LeConte's Thrasher

Toxostoma lecontei Lawrence

In the collections of the Hancock Foundation at the University of Southern California there is an egg of the bronzed cowbird which is reported to have been found in a nest of Le Conte's thrasher. Unfortunately, no locality nor date is given on the label. Since the ranges of this thrasher and of the bronzed cowbird overlap chiefly in Arizona, it seems likely that the record came from somewhere in that area; if so, the report would involve the nominate race of the host and the northwestern race, *T.a. milleri*, of the parasite.

This is the only record that has come to my attention. Since Le Conte's thrasher is a denizen of exceedingly barren and hot desert plains and valleys, the bird probably is largely ecologically allopatric

with the bronzed cowbird; accordingly, the two seldom would have contact with each other.

Orange-billed Nightingale-thrush
Catharus aurantiirostris (Hartlaub)

This thrush has been noted as a cowbird host only two times. Cherrie (1891, p. 273) saw a thrush (race *C.a. costaricensis*) feeding a fledgling bronzed cowbird (race *T.a. aeneus*) near San José, Costa Rica. In Morelos, 5 miles east of Cuernavaca, on June 10, 1959, J. Stuart Rowley (mss.) found a parasitized nest with 3 eggs of the host (race *C.a. clarus*) and 2 of the parasite (nominate race).

Solitary Vireo
Vireo solitarius (Wilson)

Brandt (1951, p. 406) recorded a nest of this vireo (subspecies *V.s. plumbeus*), with 3 eggs of its own and 1 of the western race of the bronzed cowbird, which was found late in May, 1944, at Ramsay Canyon, Arizona. Not only is this an addition to the known victims of the parasite, the race of which in this case is *T.a. milleri*, but also it is an instance of competition for hosts between the red-eyed and the brown-headed cowbirds. The latter is prone to lay its eggs in nests of vireos; the former appears seldom to use the vireo.

Yellow-green Vireo
Vireo flavoviridis (Cassin)

I know of five instances of parasitism by the bronzed cowbird on this vireo. Mr. E. J. Court told me many years ago that he had at one time in his collection a set of eggs, collected in Costa Rica, of the yellow-green vireo containing 1 egg of the bronzed cowbird. A second record of this vireo as a host of the bronzed cowbird has been mentioned by Skutch (1960, p. 26) and by Bent (1958, p. 462, *ex* Skutch). The latter was shown a nest containing three nestlings of the host and one of the parasite on July 25, 1935, in the Pacific slope area of Guatemala. In Morelos, J. Stuart Rowley (mss.) found three parasitized nests. In all these cases the nominate races of the host and of the parasite were involved.

Yellow-breasted Chat
Icteria virens (Linnaeus)

The yellow-breasted chat was recorded as a victim of the bronzed cowbird near Brownsville, Texas, by Merrill (1877, pp. 85–87). He examined many nests of the chat and, finding only one to be parasitized, he concluded that the bird was rarely imposed upon. His conclusion is upheld by the fact that just one other observer has reported

a similar occurrence since then. Dr. T. C. Meitzen (in litt.) informed me that he found a parasitized nest at Refugio, Texas. The chat in the lower Rio Grande Valley is of the race *I.v. auricollis;* the parasite, *T.a. aeneus.*

Rufous-capped Warbler

Basileuterus rufifrons (Swainson)

This warbler has recently been added to the list of hosts by J. Stuart Rowley (mss.), who found a parasitized nest at Canon de Lobos, Morelos, July 15, 1960. The local race of the warbler is *B.r. dugesi;* the cowbird is of the nominate race *T.a. aeneus.*

Mexican Cacique

Cassiculus melanicterus (Bonaparte)

At Tehuantepec, Oaxaca, Mexico, on June 11, 1955, Dr. Travis C. Meitzen (in litt.) collected a nest of this cacique containing 4 eggs of the owner and 1 of a bronzed cowbird. R. W. Dickerman (1960, p. 473) found a parasitized nest five miles southwest of Naudreete, Nayarit, on July 13, 1956. Two races of the bronzed cowbird are involved in these records, *T.a. assimilis* in Oaxaca, and *T.a. milleri* in Nayarit.

Redwinged Blackbird

Agelaius phoeniceus (Linnaeus)

I have learned of only four instances of parasitism by the bronzed cowbird on the redwinged blackbird. Two records are based on sets of eggs in the J. P. Norris collection. One was taken at Camargo, Tamaulipas, June 29, 1890, by T. H. Jackson; the other, in Hidalgo County, Texas, May 18, 1889, by J. A. Single. Dr. T. C. Meitzen has two parasitized sets of eggs from Refugio, Texas, in his collection. All four of these records refer to the race *A.p. megapotamus* of the host and to the nominate race of the parasite. There is some evidence that the redwinged blackbird is usually unmolested; at least, considerable numbers of its nests, examined around Brownsville, Texas, failed to reveal any eggs of the bronzed cowbird although that bird was locally fairly numerous.

Orchard Oriole

Icterus spurius (Linnaeus)

The orchard oriole was designated by Merrill (1877) to be a frequent host of the bronzed cowbird in the lower Rio Grande Valley, Texas. R. W. Quillen found it to be parasitized at San Antonio and in Kleberg County, Texas; Meitzen (in litt.) had the same experience at Refugio, Texas. In the J. P. Norris collection there was a parasitized set of eggs collected at Camargo, Tamaulipas. The records involve the nominate race of the parasite.

Fuertes' Oriole

Icterus fuertesi (Chapman)

Graber and Graber (1954, p. 277) have added this oriole to the known hosts of the eastern race of the bronzed cowbird. Between Tampico and Loma del Real, Tamaulipas, they found a nest containing one young each of the host and the parasite. From the locality, it is apparent that we are dealing here with the eastern, nominate race of the bronzed cowbird. The orchard oriole, *I. spurius*, a close relative of the present species, has long been known as a not uncommon victim of this parasite.

Scott's Oriole

Icterus parisorum (Bonaparte)

A single record of this oriole as a victim of the bronzed cowbird has come to my attention. Bent (1958, p. 242) stated that in southern Arizona he found it to be imposed upon by the northwestern race of the parasite, *T.a. milleri*.

Black-headed Oriole

Icterus graduacauda (Lesson)

Bendire (1895, p. 601) considered this species the most frequent victim of the bronzed cowbird; he added that, out of 9 sets of eggs in the U.S. National Museum, 7 contained from 1 to 3 of the parasitic eggs, together with 1 or 2 of their own, and that in most cases some of the latter were punctured. Near Brownsville, Texas, in 1924, I found two nests, both of which had been parasitized. In the same area, Goldman and Watson (1953, p. 320) reported seeing a pair of these orioles feeding three practically grown bronzed cowbirds. Kinball (1935, p. 59) saw a fledgling bronzed cowbird with a black-headed oriole in attendance at Los Fresnos, Texas, F. F. Nye, Jr. (in litt.), wrote me that he has two parasitized sets of eggs from southern Texas in his collection. All the Texas records refer to the nominate race of the parasite; Bendire's observations, made in Arizona, concern the race *T.a. milleri*; all the instances have to do with the race *I.g. audubonii* of the host.

Spotted-breasted Oriole

Icterus pectoralis (Wagler)

This oriole was recorded as a host of the bronzed cowbird in the lowlands of El Salvador by van Rossem (Dickey and van Rossem, 1938, p. 540). He was told by some of the local people that the bird was one of the most commonly imposed upon victims of the parasite in that area, but he did not list any specific instances. The local form of the oriole is the nominate subspecies; that of the parasite is also the nominate form.

Lichtenstein's Oriole

Icterus gularis (Wagler)

Two races of this oriole have been found to be victims of the bronzed cowbird. In El Salvador, van Rossem (Dickey and van Rossem, 1938, p. 540) was informed by the natives that this oriole is one of the most frequent victims of the parasite in the lowlands of that country. Since van Rossem cited no specific instances, it seems that he personally did not observe any but merely reported what he had been told. The nominate race of the oriole is the form breeding in El Salvador; the cowbird there is the race *T.a. aeneus*. At Monte, Tamaulipas, the race *I.g. tamaulipensis* was found to be victimized; on May 28, 1949, a nest containing 3 eggs of the oriole and 1 of the bronzed cowbird (typical *aeneus*) was discovered by Dr. Travis C. Meitzen (in litt.). Dr. Meitzen wrote me that this oriole is seldom parasitized; he had examined at least 150 nests and found eggs of the bronzed cowbird in only 2 of them.

Hooded Oriole

Icterus cucullatus (Swainson)

The hooded oriole is one of the chief fosterers of the bronzed cowbird; it has been reported as a victim in Texas (at Refugio, at Brownsville, in the Nueces River Flats), in Arizona (at Tucson, at Tombstone, near Oracle, at Sacaton, and in the Sabino Canyon), and Dickerman (in litt.) recorded it in San Luis Potosí (El Salto), Mexico.

Meitzen (in litt.) wrote me that at Refugio, Texas, he had found about a dozen parasitized nests of the hooded oriole. In his compilation, Bent (1958, p. 456) noted that as many as 6 eggs of the bronzed cowbird were found in a single nest of this oriole (by Brandt, in the Sabino Canyon). The hooded oriole has been found to rear the parasitic young (Friedmann, 1929, p. 331; Visher, 1910, p. 210). The Texas and the San Luis Potosí records refer to the race *I.c. sennetti* of the host and to the nominate race of the parasite; the Arizona instances relate to *I.c. nelsoni* and *T.a. milleri*.

Scarlet-headed Oriole

Icterus pustulatus (Wagler)

The scarlet-headed oriole has been found to be a victim of the bronzed cowbird at San Geronimo, Guatemala, by Owen (1861, pp. 61–63); in the lowlands of El Salvador, where it was one of the most frequently chosen hosts, according to van Rossem (Dickey and van Rossem, 1938, p. 540); at San Blas, Nayarit, by Bailey (1906, p. 390); at Mazatlan, Sinaloa (Schlüter, 1899); at Guaymas, Sonora, by Bancroft (Friedmann, 1933, p. 190); and near Cuernavaca, Morelos (J. Stuart Rowley, mss.). The Guatemala and El Salvador records

refer to the host race *I.p. alticola* and to the parasite race *T.a. aeneus;* the Nayarit, Sinaloa, and Sonora ones, to *I.p. microstictus* and to *T.a. milleri;* the Morelos one, to *I.p. pustulatus* and *T. a. aeneus.*

Bullock's Oriole

Icterus bullockii (Swainson)

Bullock's oriole is a frequent victim of the bronzed cowbird, but so few observations have been made in recent years that my 1929 (p. 331) account needs little change to bring it up to date.

Merrill (1877, pp. 85–87) intimated that Bullock's oriole occasionally tried to get rid of the parasitic eggs; twice he found broken shells of bronzed cowbird eggs on the ground below occupied nests. Also he once found a female cowbird hanging, with a stout fiber around its neck, from a Bullock's oriole nest. The nest contained one young of the parasite, which caused Merrill to deduce that "its parent after depositing the egg was entangled in the thread on hurriedly leaving the nest, and there died. It had been dead about two weeks." Attwater (1892, p. 237) found a parasitized nest near San Antonio. F. F. Nyc, Jr. (in litt.), found another near Pharr, Texas. The race of the oriole involved in all these records is the nominate; the parasite is also represented by its nominate form.

One uncertain record of this bird as a victim of the bronzed cowbird has been noted. In the Nueces River Flats, Texas, W. B. Savary (1936, p. 62) examined a nest of the "Baltimore oriole" containing an egg of the bronzed cowbird. The record, however, is open to question as the locality is south of the acknowledged breeding range of that oriole. Although Savary definitely states that the bird breeds there, it seems likely that his record involved Bullock's oriole, not the one to which he attributed it.

Hepatic Tanager

Piranga flava (Vieillot)

A record, recently published by Bent (1958, p. 495), adds this tanager to the list of victims of the bronzed cowbird. Bent writes that Frank C. Willard informed him that he once found an egg of the western race of the parasite in a nest of *P.f. hepatica.* Although no exact locality is given, the race of the parasite must be *milleri.* Still more recently, J. Stuart Rowley (mss.) found this tanager to be parasitized near Cuernavaca, Morelos; a nest with 3 eggs of the tanager and 2 of the parasite was found June 15, 1958. In this case the parasite was of the nominate race.

Summer Tanager

Piranga rubra (Linnaeus)

There are two records of this tanager as a victim of the bronzed cowbird, both records involving the western race, *P.r. cooperi,* of the

victim and *T.a. milleri* of the parasite. J. T. Wright saw one of these tanagers feeding and attending a fledgling of the cowbird at Saric, Sonora, August 28, 1929 (Friedmann, 1933, p. 190). Amadon (1940, p. 257) reported a parasitized set of eggs which came from Lomita Ranch, near Tucson, Arizona, and is now in the collection of the American Museum of Natural History. Apart from these records, it should be mentioned that A. R. Phillips wrote me that this tanager seemed to be a fairly regular victim in northern Sonora.

Red-headed Tanager

Piranga erythrocephala (Swainson)

The one record I published in 1938 (p. 50) is still the only one I have found of the red-headed tanager as a host of the bronzed cowbird: at Rosario, Sinaloa, J. T. Wright found a nest of this bird (subspecies *P.e. candida*) containing a nestling cowbird (*T.a.milleri*) as its sole occupant.

Cardinal

Richmondena cardinalis (Linnaeus)

The cardinal has been found to serve as a host for the bronzed cowbird in eastern and southeastern Texas. Merrill and Camp (Friedmann, 1929, p. 333) each noted instances at Brownsville many years apart; Merritt (1940, pp. 141–142) recorded another case, in Nueces County; Webster (1958, p. 427) reported one at Rockport Cottages in eastern Texas; Dr. T. C. Meitzen (in litt.) found a parasitized nest at Refugio, Texas; and F. F. Nyc, Jr., took a similar set near Pharr, Texas. The parasite in all these cases is the nominate race *T.a. aeneus;* the cardinal in eastern Texas is *R.c. magnirostris;* in southeastern Texas, *R.c. canicauda.*

Black-headed Grosbeak

Pheucticus melanocephalus (Swainson)

This bird may be added to the known hosts of the bronzed cowbird on the basis of a statement by Brandt (1951, p. 695), who found a cowbird's egg (subspecies *milleri*) in a nest of this grosbeak (nominate race) in Arizona. Unfortunately, no further details were given.

Blue Grosbeak

Guiraca caerulea (Linnaeus)

The blue grosbeak was first recorded by Sennett (1879, p. 396) as a host of the bronzed cowbird in the lower Rio Grande Valley. As far as I have been able to learn, no one else has added any further observations until recently, when I was informed by Mr. R. Kreuger (in litt.) of a set of eggs in his collection in Helsinki, Finland, containing 1 egg of the parasite as well as 4 of the host. This set was col-

lected at Oaxaca, Oaxaca, Mexico, June 3, 1936, by G. D. Smooker; it consists of the race *G.c. eurhyncha* of the grosbeak and *T.a. assimilis* of the cowbird. Sennett's instance from Texas concerns the nominate subspecies of both the host and the parasite.

Painted Bunting

Passerina ciris (Linnaeus)

The painted bunting, a frequent victim of the brown-headed cowbird, appears to be imposed upon much less often by the bronzed species. I know of only one such case; an egg of the latter bird was taken from a painted bunting's nest near San Antonio, Texas, April 1895, by H. P. Attwater, from whom it passed into the A. C. Bent Collection, now in the U.S. National Museum. The record refers to the nominate race of the parasite and to the race *P.c. pallidior* of the host.

Blue Seedeater

Amaurospiza concolor (Cabanis)

This poorly known species recently has been added by J. Stuart Rowley (mss.) to the list of victims of the nominate race of the bronzed cowbird. At Canon de Lobos, Morelos, on July 8, 1960, he found a nest of this bird (apparently of the subspecies *A.c.relicta*) containing 2 eggs of the seedeater and 1 of the bronzed cowbird.

Yellow-throated Atlapetes

Atlapetes gutturalis (Lafresnaye)

This tropical finch is known as a frequent victim of the bronzed cowbird in Costa Rica. At San José, Cherrie (1892, pp. 25–26) found five nests, four of which contained from 1 to 3 eggs each of the bronzed cowbird. Alfaro (1904, p. 180) also has recorded this host in Costa Rica. The parasite in that area is the nominate subspecies, *T.a. aeneus;* the host is of the race *A.g. parvirostris.*

Olive Sparrow

Arremonops rufivirgata (Lawrence)

Two records of bronzed cowbird parasitism on the olive sparrow have come to my notice, both reports from southern Texas. Amadon (1940, p. 257) recorded a parasitized set of eggs from Lomita Ranch, near Hidalgo; the eggs are now in the collection of the American Museum of Natural History. F. F. Nye, Jr. (in litt.), informed me that he has a similar set taken by himself in southern Texas. The records involve the nominate races of both the host and the parasite.

Green-backed Sparrow

Arremonops conirostris (Bonaparte)

As reported in an earlier paper (Friedmann, 1933, p. 191), there are three parasitized sets of eggs of this sparrow (race *A.c. richmondi*).

They were collected in Costa Rica; at present they are in German collections, one in the Schönwetter and two in the Domeier Collection. The bronzed cowbird of Costa Rica is of the nominate subspecies.

Rufous-sided Towhee

Pipilo erythrophthalmus (Linnaeus)

Bent (1958, p. 462) quoted a communication from Skutch to the effect that on June 14, 1933, Skutch saw a recently fledged bronzed cowbird attended by a pair of Guatemalan spotted towhees (*P.e. repetens*); this took place in the Guatemalan highlands, at an elevation of about 8,500 feet. The cowbird is of the nominate race, but it should be mentioned that, in his account of the birds of Guatemala, Griscom (1935, p. 387) stated that the bronzed cowbird has been noted only in clearings in the eastern lowlands. The present record would seem to extend its range well up into the highlands. This is the only instance I know of the rufous-sided towhee as a host of the bronzed cowbird.

Brown Towhee

Pipilo fuscus Swainson

The brown towhee has been recorded as a victim of the bronzed cowbird a few times—in Arizona and in the Distrito Federal, Mexico. R. S. Crossin (in litt.) found the nest of a brown towhee (race *P.f. mesoleucus*) containing one towhee egg about to hatch, one newly hatched towhee, and one bronzed cowbird egg of about five days incubation; the observation was on May 16, 1959, near Sabino Dam, Sabino Canyon, Pima County, Arizona. Visher (1910, p. 210) found this host victimized near Tucson, where he noted 2 young of the parasite being raised by a pair of brown towhees. R. W. Dickerman (1960, p. 473) found a nest of this species in Chapultepec Park, Mexico City, containing 5 eggs of the bronzed cowbird and none of the towhee. The brown towhee at that locality is *P.f. fuscus;* in Arizona it is the race *P.f. mesoleucus.* The parasite is of the nominate race in Mexico City and *T.a. milleri* in Arizona.

Sclater's Towhee

Pipilo albicollis Sclater

Four records of this towhee as a victim of the bronzed cowbird have come to my notice: one parasitized set of eggs from Etla, Oaxaca, May 20, 1912, now in the J. P. Norris collection; two similar sets also from Oaxaca, now in the Chicago Natural History Museum. Mr. J. Stuart Rowley has informed me that he recently found another case in Oaxaca. The host involved is of the nominate race; the parasite, of the race *T.a. assimilis.*

Rusty-crowned Ground Sparrow

Melozone kieneri (Bonaparte)

In Morelos, J. Stuart Rowley (mss.) found 11 nests of this sparrow, no less than 9 of which contained from 1 to 5 eggs of the bronzed cowbird. The local race of the host is *M.k. rubricatum;* the parasite is the nominate race, *T.a. aeneus.* One of the parasitized nests also contained an egg of the brown-headed cowbird.

Black-chested Sparrow

Aimophila humeralis (Cabanis)

This little known black-chested sparrow recently has been found to be a host of the nominate race of the bronzed cowbird in Morelos; J. Stuart Rowley (mss.) discovered a parasitized nest near Acatlipa on June 25, 1960.

Russet-tailed Sparrow

Aimophila ruficauda (Bonaparte)

J. Stuart Rowley (mss.) recently has added this sparrow (race *A.r. acuminata*) to the known hosts of the nominate race of the bronzed cowbird in Morelos. Near Acatlipa on July 25, 1960, he found three nests, one of which contained 1 egg of the parasite in addition to 3 of the sparrow.

Rusty Sparrow

Aimophila rufescens (Swainson)

The rusty sparrow has been recorded as a host of the bronzed cowbird in Veracruz by Sumichrast (1869, p. 551; 1870, p. 309) and by Herrera (1911, p. 124). Herrera's statement seems to be based on Sumichrast rather than on any additional data. The rusty sparrow found in Veracruz is of the race *A.r. pyrgitoides* the parasite is of the nominate race, *T.a. aeneus.* In Morelos, J. Stuart Rowley (mss.) found eight nests of this sparrow about five miles east of Cuernavaca; one of these contained an egg of the bronzed cowbird. The host in Morelos is the nominate race, *A.r. rufescens.*

Song Sparrow

Melospiza melodia Wilson

In Chapultepec Park, Mexico City, Dickerman (1960, p. 472) found 13 nests of the song sparrow, of which 6 proved to contain eggs or young of the bronzed cowbird. The number of parasitic eggs varied from 1 to 3 in these nests. The 13 nests contained a total of 14 eggs and six young of the sparrow plus 13 eggs and two young of the cowbird. Dickerman reported that some of the parasitized nests had been deserted, but it is not clear if they had already been abandoned when the parasite laid in them or if the desertion was due to its visits. The local race of the song sparrow is *M.m. mexicana;* the cowbird, *T.a. aeneus.*

Shiny Cowbird

Molothrus bonariensis (Gmelin)

Discussion

As stated in the introductory pages of this report, there is no pressing need for a complete, new, annotated catalog of the victims of this wide-ranging cowbird of South America: there has not been such a demand as has been expressed in the case of the brown-headed and the bronzed species of North America. The original host list given in my 1929 book, the various supplements to it, and the new material now presented, are here brought together and summarized in tabular form, but written accounts are given only for the additional hosts and for those in which significant new information alters or extends our earlier estimates of them as cowbird victims. In the table, the nomenclature of all the earlier publications has been brought into agreement with current usage.

In the decades since my 1929 book, disappointingly little has been added to many aspects of our knowledge of the breeding habits of the shiny cowbird and of the main features of its host relationships. There seems, therefore, to be little need to elaborate upon many of the statements made in my earlier publication, and only topics that have been developed since or that were not adequately treated then will be discussed here. The newer record data are given chiefly in connection with the individual host species involved. In addition to the following discussion the reader interested in reviewing the over-all picture should consult pages 81–91 of my 1929 description of the subject, and pages 91–121 for the accounts of the hosts known at that time.

Imperfections in Host Relations

Apart from some important differences in its choice of hosts, as already discussed in the present report (pp. 9–10), the shiny cowbird is essentially similar in its brood parasitism to the better known brown-headed species, but it does exhibit one imperfection in its breeding habits that has not been found in its more advanced northern relative. Since this affects its host relations, it merits discussion here.

The fecundity of the shiny cowbird is less closely and less accurately geared to the availability of potential hosts than is that of its North American counterpart. In his pioneer work in Argentina in the 1860's, Hudson noted that the shiny cowbird wasted numbers of its eggs by laying them on the ground and simply leaving them or, not

infrequently, by utilizing deserted nests. In Salta, northwestern Argentina, Hoy (in litt.) also has noted eggs on the ground or in deserted nests. As discussed more fully below (pp. 193–194), it may be noted that late in the southern summer the year-old birds tend to remain in flocks and that individuals therein lay large numbers of eggs in sizeable nests which either have been already deserted or are quickly abandoned as a result of the parasites' mass visitations.

Careful reading of Hudson's statements conveys the impression that finding scattered eggs on the ground was frequent in his experience and that it was not restricted to the late summer months. In Hoy's experience in Salta such evidence of wasted eggs chiefly was found early in the breeding season. In other words, it was not restricted to year-old, inexperienced birds. It is still somewhat puzzling to me, as during six months that I spent in the field in Argentina, paying attention particularly to the cowbirds in areas where they were very numerous, I never came across such a deserted egg. I do not doubt that Hudson found many, but I can only wonder if this might have been a local condition brought about by undue destruction of available nests by weather or predators or by an undue numerical abundance of cowbirds there. Furthermore, it is conceivable that Hudson may have unwittingly multiplied his experiences in his memory, when writing about them, by attaching too much inferential significance to a relatively few such instances. At that time it was thought not improbable that the cowbirds laid their eggs on the ground and then carried them in their bills to the nests in which they were finally placed. This was the current, although fallacious, assumption concerning the European cuckoo, at that time the best known parasitic bird. There is no longer any reason to assume that either cowbirds or cuckoos do this. Actually, the only way in which it ever became known to Hudson that the shiny cowbird did sometimes lay on the ground was the fact that the eggs were left there and were not carried to a nest and that they were found subsequently by him and his co-observers.

We still know too little about the actual or the potential fecundity of the shiny cowbird to be able to estimate with any accuracy the percentage of its eggs that are wasted by depositing them either on the ground or in abandoned nests. However, the waste is real, and it is an element largely absent in the case of the brown-headed cowbird.

Still another thought must be expressed in this connection. Ordinarily, cowbirds and, for that matter, parasitic birds in general, find the nests they subsequently parasitize by watching the hosts build them. There is even some reason to discern in this watching a stimulus to ovulation. Therefore, depositing eggs on the ground or in old, abandoned nests implies that this important directing and connecting circumstance somehow is lacking in these cases. This, in turn,

suggests a less close and accurate coordination between the ovulation of the parasite and the nesting activity of the prospective hosts.

The point is an important one, and to emphasize it, by contrast, we may cite one of Hann's conclusions (1941, p. 220) from his careful and protracted study of the brown-headed cowbird in relation to the ovenbird, *Seiurus aurocapillus*, in Michigan. He found that the female cowbird made regular inspection trips to nests during the absence of the owners, between the time of first discovery of the nest and the time of her own egg-laying, and that she seemed to know in advance where she was going to lay. This is certainly a contrast to the condition of misplaced ovulation we have just described in the shiny cowbird.

A further consideration emerges from these data. There is some reason to think that in a parasitic bird with well-marked individual host specificity, such as the European cuckoo, the individual hens lay their eggs in nests of the same species of host as those by which they themselves were reared. A cuckoo raised by a meadow pipit later tends to lay its eggs in meadow pipits' nests, while another individual that has been reared by a hedge sparrow uses nests of that species for its own eggs. There is no evidence of a comparable degree of obligate host restriction in the shiny cowbird although there is what appears to be a high degree of it in the ancestral screaming cowbird stock. The habit of dropping eggs indiscriminately on the ground, not even in a nest at all, or of using old deserted nests clearly suggests the absence of any trace of a tendency toward host specificity. The inference here is clearer and more direct than in the more usual instances of nest parasitism by this cowbird, as in the bulk of those cases we have no evidence to suggest or to dismiss the possible effect, or even existence, of ontogenetic host preference.

One other relative imperfection—like the preceding, also a source of loss to the parasite and not to its hosts—is the lack of "understanding" or the lack of proper attunement in communication between the alarm calls of the hosts and the response of the parasite during its nestling and early fledgling stages. When danger in the form of a hawk or other predator threatens, the young cowbird appears to be unaffected by the seemingly obvious distress calls of its foster-parents. Instead of crouching quietly, it clamors noisily for food as if no peril were imminent. This often results in its being captured and eaten by the instigator of the alarm it failed to comprehend. Many years ago Hudson commented on this in central eastern Argentina, and I had essentially the same experience in the same and other parts of that country. Hudson noticed that in his area a large proportion of the nests of the cachila pipit, (*Anthus correndera* were parasitized, but that it was a rare thing to find a young fledgling cowbird,

since the chimango hawk, *Milvago chimango*, was common there and picked off the noisy fledglings to feed its young.

Hudson's comments (1920, pp. 82–86) are worth repeating. "The young of *Synallaxis spixi*, though in a deep domed nest, will throw itself to the ground, attempting thus to make its escape. The young *Mimus patagonicus* sits close and motionless, with closed eyes, mimicking death. The young of our common *Zenaida*, even before it is fledged, will swell itself up and strike angrily at the intruder with beak and wings; and by making so brave a show of its inefficient weapons it probably often saves itself from destruction. But anything approaching the young *Molothrus* is welcomed with fluttering wings and clamorous cries, as if all creatures were expected to minister to its necessities.

"I found a young *Molothrus* in the nest of a Screaming Finch, *Sporophila caerulescens;* he cried for food on seeing my hand approach the nest; I took him out and dropped him down; when finding himself on the ground he immediately made off half flying. I succeeded in recapturing him, and began to twirl him about, making him scream so as to inform his foster-parents of his situation, for they were not by at the moment. I then put him back in the nest, and plucked half a dozen large measure worms from an adjacent twig. The caterpillars were handed to the bird . . . and with great greediness he devoured them all notwithstanding the ill treatment he had just received and utterly disregarding the wild excited cries of his foster-parents, just arrived and hovering within three or four feet of the nest . . . ."

Some lack of attunement between the reaction of the parasitic nestling or fledgling and those of its foster-parents exists in the brown-headed cowbird as well as in the shiny one, but it appears to be more noticeable and more disastrous to the species in the shiny cowbird than in its North American relative.

Frequency of Host Selection

Although it is entirely parasitic in its breeding, the shiny cowbird generally evinces more interest in nests than does the brown-headed cowbird. This interest is shown by males as well as females before and after, as well as during, their breeding season. In Argentina I often noticed both males and females of this species examining nests of ovenbirds, *Furnarius*, and of woodhewers, *Anumbius*, *Synallaxis*, etc., without actually entering them. My observations were anticipated by many years by Hudson, who wrote (1874, pp. 171–172) that this interest did not seem like idle curiosity but "precisely like that of birds that habitually make choice of such breeding places. . . . Whenever I set boxes up in my trees the female Cowbirds were the

first to visit them. . . . It is amusing to see how pertinaciously they hang about the ovens of the Ovenbirds, apparently determined to take possession of them, flying back after a hundred repulses, and yet not entering them when they have the opportunity. Sometimes one is seen following a wren to its nest beneath the eaves, and then clinging to the wall beneath the hole into which it disappeared. I could fill many pages with instances of this habit of *M. bonariensis*, which useless though it be, is as strong an affection as the bird possesses. That it is a recurrence to a long disused habit I can scarcely doubt . . . it seems to me that if *M. bonariensis* when once a nest builder, had acquired the semiparasitical habit of breeding in doomed nests of other birds, such a habit might conduce to the formation of the instinct which it now possesses . . . . "

If we recall that the bay-winged cowbird still prefers the old nests of ovenbirds and woodhewers for its breeding and that the species will build its own nest mainly if no others are available, the interest shown by the shiny cowbird seems to be a relict habit from the self-breeding mode of life of its remote ancestral stock. This is borne out by the fact that the male shows this interest as well as the female; in the bay-wing, both sexes may struggle with the builders for the possession of their nest or share in the construction of a new one. Related to this is the observation of Young (1930, pp. 256–257) to the effect that, in his experience in British Guiana, the male shiny cowbird seemed to do most of the work of prospecting for nests.

Other suggestive evidence pertinent to the above is the tendency of year-old shiny cowbirds breeding in flocks late in the season to lay very large numbers of eggs in some of these domed nests, especially the mud nests of the ovenbird. Individual nests of this bird have been found which contained 15, 17, 20, 25, 26, and even, in one case, 37 eggs of the shiny cowbird. In all such cases the nests were deserted, often before most of the parasitic eggs were deposited. All of these instances were noted late in the breeding season—in January (the season extends from September to February). No such multiple depositions of eggs in single nests have been recorded early in the season although, as in the North American brown-headed cowbird, cases of 8 eggs in a nest occasionally have been noted. In Salta, in northwestern Argentina, Leo Miller (1917, pp. 584) noted that, in many of these instances of excessive parasitism, flocks of shiny cowbirds were seen in the same tree as the overburdened nest. In my original appraisal of this situation (1929, p. 97) I pointed out that "in migration and in the establishment of breeding areas the adult Cowbirds come first and the year-old birds follow a good deal later. . . . most of the adults would be through breeding before the year-old birds and from this it follows that the latest eggs of the season would

probably be those of the younger birds. Then too, by the time the year-old birds were ready to begin laying, all the district would have been already staked out into territories by the adults. From this it follows that there would be a tendency for the yearling birds to congregate in whatever places were left. Also most small birds would be through breeding and their nests either destroyed by the elements or hard to find as the Cowbirds usually find such nests by watching the birds coming and going. . . . if the year old Cowbirds found large nests it would not be surprising if many of them would lay in each one and not only once at that. It should be remembered that of 217 Ovenbirds' nests found early in the season (September through December), only 20 contained Cowbirds' eggs, so that these are not [so greatly] favored by the *Molothrus* when they can avail themselves of nests of smaller birds, as *Brachyspiza, Muscivora,* etc. I think that the large clutches of 25 and 37 eggs are the product of year-old birds without territories . . . ." It may be added that Miller estimated, from the appearance of the eggs in a nest containing 25 of them, that at least 12 hen cowbirds were responsible. It may also be mentioned that a fair number of these late-breeding males still showed some of the juvenal remiges; thus they were clearly year-old birds. The plumage of the females unfortunately is of a kind as to give no opportunity for such revealing criteria of age.

The pertinence of the above is, as already stated, merely suggestive. The younger birds show an active interest in these domed nests and less so in open ones. Since atavistic traits and tendencies seem to crop up more often in younger than in older birds, these factors may be operative here. It must be admitted that these late breeding, year-old birds also may occasionally use open nests for their wasteful multiple ovulation. Nests of the yellow-breasted marsh bird, *Pseudoleistes virescens,* have been reported with from 10 to 17 cowbird eggs in them. One nest of a mockingbird, *Mimus saturninus modulator,* with 14 cowbird eggs, the product of at least seven hens, was found very late in the season (February 12). Ottow (in litt.) studied 14 cowbird eggs, found on January 10 in another nest of this mockingbird, and attributed them to 14 different hen cowbirds. Nests of *Leistes militaris superciliaris* also have been reported with as many as 19 cowbird eggs in them.

That the interest in domed nests is more atavistic than currently useful is indicated by the frequency with which the various kinds of hosts actually are chosen. The data in our present host catalog involve between 825 and 900 parasitized nests; of these, 165 were nests of *Zonotrichia capensis,* no less than 10 races of which species are known to be parasitized. The second most frequent, although geographically restricted, host is *Diuca diuca,* with 80 records; the third, *Muscivora*

tyrannus, with 57; the fourth is one of the domed-nest builders, *Furnarius rufus*, with 38 instances; the fifth, *Mimus triurus*, with 28; then *Agelaius ruficapillus* and *Troglodytes musculus*, with 15 records each. The chingolo, *Zonotrichia capensis*, is, as far as present data indicate, the primary host, with a very wide geographic range over which it has been found to serve as a fosterer—Argentina, Chile, Bolivia, and Brazil as far as Peru and Venezuela. In Chile, where the shiny cowbird appears to be a fairly recent addition to the fauna, the main host is the diuca finch, *Diuca diuca*. Goodall, Johnson, and Phillippi (1946, p. 130) wrote that, of 100 nests found in Chile with cowbird eggs in them, 72 were of the diuca finch. The domed-nest builders other than *Furnarius*—*Anumbius*, *Synallaxis*, *Cranioleuca*, *Phacellodomus*, etc.—have only one or two known records of parasitism apiece. In the case of the rufous ovenbird, *Furnarius rufus*, the one species of domed-nest builder that is frequently parasitized, it may be noted that, of 217 of its nests examined by me in Argentina, only 20 contained eggs or young of the shiny cowbird. In other words, current use of domed nests as repositories for eggs of the shiny cowbird indicate that the nests are used less by the parasite than its interest in such structures would suggest.

In some areas, observers have credited other species as the most frequently imposed upon hosts even though actual instances in sufficient quantity are not yet recorded. In British Guiana coastlands, Young (1929) called the white-headed marsh tyrant, *Arundinicola leucocephala*, the commonest victim of the shiny cowbird, while others have so characterized the wren, *Troglodytes musculus*. The last named bird is stated by Haverschmidt (1955, p. 127) to be the principal host in Surinam. In response to an inquiry, Mr. Haverschmidt has told me of at least 11 such records in 15 years in his own experience in Surinam (and only a single record of another host species!). A similar great use of this wren was reported also from Trinidad by Herklots (1961, p. 222), who found as many as 3 eggs of the parasite in individual nests of the small fosterer. This is certainly different from the situation in Argentina.

On the other hand, as Sick (1957, pp. 16–17) has noted, the introduced and now wide-spread European house sparrow, *Passer domesticus*, has not been "accepted" by the cowbirds as a host although Sick has found, near Rio de Janeiro, mixed groups of the two species sleeping together in small roosts. The fact that there is one instance on record of the shiny cowbird's parasitizing the house sparrow does not alter the general validity of Sick's comments.

While no one has stated in so many words that the shiny cowbird exhibits any tendency toward individual specificity in its choice of hosts, the observations of Sick and Ottow (1958) in the vicinity of

Rio de Janeiro constitute strong evidence that a number of the female cowbirds they studied were restricted to one host species, the chingolo sparrow, *Zonotrichia capensis*, even though other potential victims nesting in the area were seasonally and ecologically available. It is possible that something of this sort may be involved in the case of the wren *Troglodytes musculus* in Surinam. There, however, the evidence is as yet less explicit and less impressive.

Destruction of Host Eggs by Parasite

As in the case with many parasitic birds, the shiny cowbird destroys many eggs of its hosts before, after, or at the time of the laying of its own eggs in their nests. In the species, however, there is some evidence that the habit of deliberately puncturing eggs with its bill has become established beyond any immediate or even approximate correlation with its own ovulation. In Salta, northwestern Argentina, Hoy (mss., 1961) found that this cowbird continued to destroy eggs of other birds long after its own breeding season. Not only was the habit unduly protracted, but also it was continued with undiminished frequency. Egg destruction was not limited to female cowbirds but was indulged in by males as well. On January 26 Hoy was watching the nest of a tanager, *Thraupis bonariensis*, which nest contained no cowbird eggs and 3 tanager eggs. When the incubating bird left the nest for a moment, a male shiny cowbird suddenly appeared, went directly to the nest and immediately destroyed all 3 eggs by pecking holes in them.

It is well established that egg-pecking is far from universal; many parasitized nests show no such activities. The situation is thus similar to that of the brown-headed cowbird, with the important difference that, in the latter case, egg-pecking is restricted to nests already parasitized or about to be parasitized—and only to such nests. In other words, there is a close correlation between egg-laying and egg-pecking in the brown-headed species but not in the shiny cowbird.

Hosts Known To Have Reared Young of the Parasite

The present host catalog is heavily weighted with records of eggs which were seen and collected instead of being allowed to hatch and thus afford an opportunity to watch the young develop. This necessarily increases the number of cases wherein we have no definite information that the host could and would rear the parasitic young, but the absence of such data cannot be taken as meaningful. Of the 146 species in our present list, the 26 listed below have been reported as

having reared young shiny cowbirds. This number will undoubtedly increase with further field study.

It is worth noting that one of the most frequently imposed upon victims, the fork-tailed flycatcher, *Muscivora tyrannus*, for which some 57 records of parasitism are available, has not yet been reported as having reared the parasitic young. In this species the earlier observations, especially those of Hudson (1874, pp. 153–154), indicated that the much harassed flycatcher frequently deserted its nest because of excessive parasitism; in some instances its own eggs were outnumbered 3 to 1 by those of the parasite.

rufous ovenbird, *Furnarius rufus*
firewood gatherer, *Anumbius anumbi*
white-naped ant shrike, *Sakesphorus bernardi*
white-headed marsh tyrant, *Arundinicola leucocephala*
short-tailed ground tyrant, *Muscigralla brevicauda*
bellicose tyrant, *Tyrannus melancholicus*
reed tyrant, *Pseudocolopterix flaviventris*
South American house wren, *Troglodytes musculus*
Patagonian mockingbird, *Mimus patagonicus*
long-tailed mockingbird, *Mimus longicaudatus*
calandria, *Mimus saturninus*
white-banded mockingbird, *Mimus triurus*
dusky thrush, *Turdus amaurochalinus*
red-bellied thrush, *Turdus rufiventris*
brush gnatcatcher, *Polioptila dumicola*
bicolored ateleodacnis, *Ateleodacnis bicolor*
golden warbler, *Dendroica petechia*
Swainson's grackle, *Holoquiscalus lugubris*
Grace's oriole, *Icterus grace-annae*
blue and yellow tanager, *Thraupis bonariensis*
grayish saltator, *Saltator coerulescens*
orange-billed saltator, *Saltator aurantiirostris*
screaming seedeater, *Sporophila caerulescens*
Diuca finch, *Diuca diuca*
Chingolo sparrow, *Zonotrichia capensis*
black and chestnut warbling finch, *Poospiza nigro-rufa*

New information on the life histories of Neotropical birds accumulates very slowly compared with the rate of progress in our knowledge of the systematics and distribution of these creatures. In view of the paucity of observers in South America, it is all the more pleasant to be able to note and extract interesting data from two important and recently published studies from opposite sides of that continent. Marchant (1958, 1960) has brought to the attention of ornithologists the first information available on the brood-hosts of the Ecuadorian race of the shiny cowbird (*M.b. aequatorialis*), and Sick and Ottow (1958) have made a significant study of this parasite and the chingolo sparrow, its chief victim, in southeastern Brazil. In addition to these, Ottow and Hoy (mss., 1961) have made interesting studies in

northeastern Argentina, and they have generously sent me data from their unpublished work.

When one considers the vast geographic range of the shiny cowbird—from Patagonia to the Colombian-Panamanian border and to some of the islands of the West Indies—and when one also considers the very large number of available host species in all of that diversified area, it is obvious that the known instances of host choice by the shiny cowbird are still little more than a sampling of what one may expect to be reported in time. A slight inkling of this may be gathered from Mrs. Mitchell's experience in Brazil (1957, pp. 204-205), where she recorded seeing a female shiny cowbird attempting unsuccessfully to enter the nest of a becard, *Platypsaris rufus*, and of a flycatcher, *Satrapa icterophrys*, both of which probably will be found eventually to be victimized there; as yet this fact has not been recorded. And these are the relatively casual observations of one observer in a limited area! It is true that in some parts of South America, such as most of Argentina (except the extreme north), Uruguay, and southeastern Brazil, we probably now know the victims most frequently imposed upon by the parasite. On the other hand, there are many species of birds that seem to be utilized rather seldom but only because, so far, merely a few records have been noted by occasional observers. South American birds have yet to be adequately studied by sufficient numbers of observers.

The earlier reports in this series have become exceedingly difficult for readers to use and compare because of numerous changes in nomenclature and systematic treatment of the various species and subspecies involved. In a few cases, what had been recorded as separate forms now have been united; others have been divided in ways that are different from earlier usage. To give a composite picture of the present state of knowledge, I am including in tabular form a list of all the known hosts, divided into races both of the host and of the parasite. In this table no columns have been made for two races of the shiny cowbird, *nigricans* and *riparius*, for the reason that so far no host records are available for them. A perusal of this table shows that the host list for *Molothrus bonariensis* now includes 193 species and subspecies (148 species) of birds, as compared with 98 forms (82 species) in my 1929 list.

Hosts of the Shiny Cowbird

Summary

Host	*Molothrus bonariensis*						
	bonariensis	*minimus*	*venezuelensis*	*cabanisii*	*occidentalis*	*aequatorialis*	*melanogyna*
Metriopelia melanoptera melanoptera	x						
Xiphorhynchus picus dugandi				x			
Furnarius rufus albigularis	x						
" " commersoni	x						
" " paraguayae	x						
" " rufus	x						x
" cristatus	x						
Leptasthenura aegithaloides pallida	x						
Synallaxis spixi	x						
Synallaxis albescens australis	x						
Certhiaxis cinnamomea cinnamomea		x					
Cranioleuca vulpina alopecias			x				
" pyrrhophia pyrrhophia	x						
Asthenes hudsoni	x						
" baeri baeri	x						
Phacellodomus ruber	x						
" striaticollis striaticollis	x						
Anumbius anumbi	x						
Taraba major major	x						
Sakesphorus bernardi bernardi						x	
Thamnophilus ruficapillus ruficapillus	x						
Rhinocrypta lanceolata lanceolata	x						
Xenopsaris albinucha	x						
Pachyramphus polychopterus spixii	x						
Xolmis cinerea	x						
Xolmis irupero irupero	x						
" pyrope	x						
Knipolegus cyanirostris	x						
" cabanisi	x						
Lichenops perspicillata perspicillata	x						
" " andina	x						
Fluvicola pica pica		x					
" " albiventer	x						
Arundinicola leucocephala		x					
Pyrocephalus rubinus rubinus	x						
Muscigralla brevicauda						x	
Satrapa icterophrys	x						
Machetornis rixosa rixosa	x						
Muscivora tyrannus tyrannus	x						
Tyrannus melancholicus melancholicus	x						
Empidonomus varius varius							x
" aurantio-atrocristatus aurantio-atrocristatus	x						
Myiodynastes solitarius	x						
Pitangus sulphuratus maximiliani	x						
" " bolivianus	x						
Myiophobus fasciatus flammiceps	x						
" " fasciatus		x					
Pseudocolopterix flaviventris	x						
Serpophaga nigricans	x						

Summary—Continued

Host	*Molothrus bonariensis*						
	bonariensis	*minimus*	*venezuelensis*	*cabanisii*	*occidentalis*	*aequatorialis*	*melanogyna*
Elaenia flavogaster flavogaster		x					
" albiceps chilensis	x						
Sulrirl suirirl	x						
Phaeoprogne tapera fusca	x						
Iridoprocne leucorrhoa	x						
Heleodytes miuor albicillius				x			
" unicolor	x						
" fasciatus pallescens					x		
Thryothorus leucotis leucotis				x			
" supercillaris superciliaris						x	
" rutilus rutilus	x	x					
Troglodytes musculus clarus		x	x				
" " tobagensis		x					
" " musculus	x						
" " audax					x		
" " chilensis	x						
" " bonariae	x						
Mimus gilvus melanopterus		x					
" " tobagensis		x					
" patagonicus	x						
" thenca	x						
' longicaudatus longicaudatus					x		
" " albogriseus						x	
" saturninus frater							x
" " modulator	x						
" triurus	x						
Turdus falklandil magellanicus	x						
" amaurochalinus	x						
" leucomelas albiventer			x				
" rufiventris rufiventris	x						x
" nlgriceps	x						
" chiguanco anthracinus	x						
Polioptila dumicola dumicola	x						
Anthus lutescens lutescens	x						
" " peruvianus					x		
" correndera chilensis	x						
" " correndera	x						
Cyclarhis gujanensis viridis	x						
Vireo flavoviridis chivi	x						x
" " griseobarbatus						x	
" " vividior		x					
Hylophilus aurantiifrons saturatus		x					
Dacnis cayana cayana		x					
Ateleodacnis bicolor bicolor		x					
Dendroica petechia ruficapilla		x					
" " petechia		x					
Geothlypis aequinoctialis velata	x						x
Passer domesticus	x						

Summary—Continued

Host	*Molothrus bonariensis*						
	bonariensis	*minimus*	*venezuelensis*	*cabanisii*	*occidentalis*	*aequatorialis*	*melanogyna*
Archiplanus albirostris	x						
Molothrus badius badius	x						
Macroagelaius subalaris imthurmi		x					
Holoquiscalus lugubris lugubris		x	x				
" fortirostris fortirostris		x					
Dives dives warszewiczi					x		
Icterus bonana		x					
" cayanensis pyrrhopterus							x
" chrysocephalus		x					
" grace-annae						x	
" chrysater giraudii				x			
" nigrogularis nigrogularis				x			
" " trinitatis		x					
" jamacaii croconotus		x					
Gymnomystax mexicanus			x				
Agelaius thilius thilius	x						
" " petersi	x						
" icterocephalus icterocephalus		x					
" ruficapillus ruficapillus	x						
Xanthopsar flavus	x						
Amblyramphus holosericeus	x						
Gnorimopsar chopi chopi	x						x
Pseudoleistes guirahuro	x						x
" virescens	x						
Leistes militaris militaris		x					
" " superciliaris	x						
Pezites militaris bellicosa						x	
" " militaris	x						
" defilipii	x						
Thraupis virens nesophila		x					
" " cana			x				
" sayaca sayaca	x						x
" palmarum palmarum	x						
" ornata							x
" bonariensis bonariensis	x						
Ramphocelus bresilius dorsalis	x						x
" carbo magnirostris		x					
Piranga flava flava	x						
" " saira							x
Tachyphonus rufus		x	x	x			
Thlypopsis sordida sordida	x						
Saltator similis similis							x
" coerulescens plumbeus				x			
" " coerulescens	x						
" aurantiirostris aurantiirostris	x						
Pitylus fuliginosus	x						
Gubernatrix cristata	x						
Paroaria coronata	x						

Summary—Continued

Host	*Molothrus bonariensis*						
	bonariensis	*minimus*	*venezuelensis*	*cabanisii*	*occidentalis*	*aequatorialis*	*melanogyna*
Paroaria gularis gularis							x
" " nigro-genis		x					
" capitata	x						
Pheucticus chrysopeplus chrysogaster						x	
" aureo-ventris aureo-ventris	x						
Cyanocompsa cyanea argentina	x						
" " minor		x					
Loxigilla noctis barbadensis		x					
Piezorhina cinerea					x		
Sporophila caerulescens caerulescens	x						
" minuta minuta		x					
Oryzoborus crassirostris		x					
" angolensis angolensis	x						
Spinus magellanicus ictericus	x						
" barbatus	x						
Sicalis auriventris	x						
" flaveola flaveola				x			
" " holti	x						x
" " pelzelni	x						x
" luteola luteiventris	x						
Diuca diuca diuca	x						
" " minor	x						
Phrygilus patagonicus	x						
" unicolor unicolor					x		
Coryphospingus cucullatus rubescens	x						x
" pileatus pileatus	x						
Atlapetes citrinellus	x						
Aimophila strigiceps dabbenei	x						
Myospiza humeralis humeralis							x
" " xanthornus	x						
Zonotrichia capensis peruviensis					x		
" " pulcayensis	x				x		
" " chilensis	x						
" " choraules	x						
" " argentina	x						
" " hypoleuca	x						
" " matutina							x
" " subtorquata	x						
" " capensis			x				
" " venezuelae			x				
Emberizoides herbicola herbicola	x						
Poospiza melanoleuca	x						
Poospiza nigro-rufa nigro-rufa	x						
" " whitii	x						
" lateralis cabanisi	x						x
Saltatricula multicolor	x						
Embernagra platensis platensis	x						
" " olivascens	x						

Since the last addendum to the known fosterers (Friedmann, 1949, pp. 154–157), 24 additional species and subspecies of birds have been found to be parasitized by this cowbird, bringing the corrected total up to 193 forms. The new hosts are listed below.

Cranioleuca pyrrhophia pyrrhophia (Vieillot)
Asthenes baeri baeri (Berlepsch)
Sakesphorus bernardi bernardi (Lesson)
Xolmis cinerea (Vieillot)
Muscigralla brevicauda Lafresnaye and d'Orbigny
Pitangus sulphuratus maximiliani (Cabanis and Heine)
Thryothorus superciliaris superciliaris Lawrence
Troglodytes musculus tobagensis Lawrence
Mimus longicaudatus albogriseus Lesson
Turdus falklandii magellanicus King
Vireo flavoviridis griseobarbatus (Berlepsch and Taczanowski)
Dacnis cayana cayana (Linnaeus)
Dendroica petechia ruficapilla (Gmelin)
Macroagelaius subalaris imthurmi (Sclater)
Icterus bonana (Linnaeus)
Icterus chrysocephalus (Linnaeus)
Icterus grace-annae Cassin
Icterus chrysater giraudii Cassin
Icterus jamacaii croconotus (Wagler)
Pezites militaris bellicosa (Filippi)
Pheucticus chrysopeplus chrysogaster (Lesson)
Oryzoborus angolensis angolensis (Linnaeus)
Aimophila strigiceps dabbenei (Hellmayr)
Zonotrichia capensis subtorquata Swainson

In addition to the above, some other birds previously known as fosterers of one race of the parasite, have now been found to serve in this manner for other races as well. To simplify matters, we may list the new hosts by subspecies of the cowbird before considering them individually.

The following are additions to the recorded victims of the nominate form of the cowbird, *M.b. bonariensis*, bringing its list of known hosts up to 122 forms.

Cranioleuca pyrrhophia pyrrhophia (Vieillot)
Asthenes baeri baeri (Berlepsch)
Xolmis cinerea (Vieillot)
Pitangus sulphuratus maximiliani (Cabanis and Heine)
Turdus falklandii magellanicus King
Oryzoborus angolensis angolensis (Linnaeus)
Aimophila strigiceps dabbenei (Hellmayr)
Zonotrichia capensis subtorquata Swainson

The Ecuadorian race of the shiny cowbird, *M.b. aequatorialis*, none of whose hosts previously have been recorded by me, has recently been found to parasitize the following eight birds.

Sakesphorus bernardi bernardi (Lesson)
Muscigralla brevicauda Lafresnaye and d'Orbigny
Thryothorus superciliaris superciliaris Lawrence
Mimus longicaudatus albogriseus Lesson
Vireo flavoridis griseobarbatus Berlepsch and Taczanowski
Icterus grace-annae Cassin
Pezites militarus bellicosa (Filippi)
Pheucticus chrysopeplus chrysogaster (Lesson)

To the previously listed fosterers of the small, northern race of the cowbird, *M.b. minimus*, the following are added, bringing the total up to 34 forms. This race is extending its range in the West Indian area, an expansion which brings it into contact with new potential hosts.

Troglodytes musculus tobagensis Lawrence
Dacnis cayana cayana (Linnaeus)
Dendroica petachia ruficapilla (Gmelin)
Macroagelaius subalaris imthurmi (Sclater)
Icterus bonana (Linnaeus)
Icterus chrysocephalus (Linnaeus)
Icterus jamacaii croconotus (Wagler)

Two additions to the hosts of the Venezuelan race of the shiny cowbird, *M.b. venezuelenis*, are here recorded, bringing its known fosterers to a total of 10.

Holoquiscalus lugubris (Swainson)
Icterus nigrogularis nigrogularis (Hahn)

Single records of two additional hosts of the large Colombian race of the parasite, *M.b. cabanisii* have come to my attention, bringing its known hosts up to 8 forms.

Icterus chrysater giraudii Cassin
Tachyphonus rufus (Boddaert)

In the following catalog the pertinent data are given for these additional hosts and also new data on previously listed hosts in cases where the information appreciably alters our understanding and our earlier summation.

Stripe-crowned Spinetail

Cranioleuca pyrrhophia (Vieillot)

This spinetail recently has been added to the known hosts of the shiny cowbird in the Province of Salta, northwestern Argentina, by Gunnar Hoy, to whom I am indebted for the information. The nominate races of both host and parasite are involved in this record.

Baer's Spinetail

Asthenes baeri (Berlepsch)

The first records of this spinetail as a host of the shiny cowbird only recently have come to my attention—all of them from parasitized nests found near Salta, northwestern Argentina, by Gunnar Hoy, according to Dr. Johann Ottow (in litt., 1961). The nominate race of host and of parasite are involved here. Further details, received directly from Hoy, indicate that this bird is rather frequently victimized and that as many as 3 cowbird eggs have been found in one nest. Hoy found that the host usually accepted and incubated the parasitic eggs. "As usual, the *Asthenes* would not forsake the nest for an egg or two of the cowbird. In some cases it would incubate even three, but I never saw it incubate four."

Hoy noted a peculiar situation for which, with present information, no explanation can be advanced. *Asthenes baeri* and another spinetail, *Phacellodomus rufifrons sincipitalis*, are both common locally; both build similar types of nests in similar places, the nests of the latter differing from those of the former only in their somewhat larger size. Despite the similarity, the shiny cowbird parasitizes the former of these two and apparently does not show any interest in the latter. Yet the nonparasitic bay-winged cowbird, *Molothrus badius*, uses with equal frequency old nests of both of these spinetails for its own breeding site.

Firewood-gatherer

Anumbius anumbi (Vieillot)

To the single earlier record listed by me (1938, p. 43), may be added one more. G. Harrison (1950, p. 6) mentions an egg of the shiny cowbird taken with a set of eggs of the firewood-gatherer. Apparently it was collected in Argentina, which was the locality in the earlier case. The large stick nests of this and other woodhewers are not particularly favored by the shiny cowbird.

White-naped Ant Shrike

Sakesphorus bernardi (Lesson)

The white-naped ant shrike is a recent addition to the recorded hosts of the shiny cowbird, which was reported in this capacity from the Santa Elena peninsula of southwestern Ecuador by Marchant (1958, p. 384; 1960, p. 369, 584). The typical race of the host and the race *M.b. aequatorialis* of the parasite are involved here. Marchant observed four parasitized nests, of which only one produced a young cowbird; two were total losses, with their included eggs, and in a third the cowbird egg disappeared before the host young was well along in its development.

Gray Pepoaza

Xolmis cinerea (Vieillot)

This flycatcher has been found to be parasitized in the state of Minas Geraes, Brazil, by the local race of the shiny cowbird (*M.b. bonariensis*). The report was made by Chagas (in litt.). There are no previous records of this bird as a cowbird victim.

Widow Pepoaza

Xolmis irupero (Vieillot)

Recently Hoy (mss., 1961) near Salta, northwestern Argentina, found that this flycatcher, which breeds in old nests of the ovenbird, *Furnarius rufus*, is parasitized regularly by the shiny cowbird. Judging from his experience of finding broken cowbird egg shells on the ground beneath such nests, he concluded that *Xolmis* showed a

tendency to throw out the parasitic eggs. Prior to Hoy's observations, this flycatcher had been noted as a cowbird victim a few times in the province of Tucuman, not very far to the south of Salta. The nominate race of host and of parasite are involved in both cases.

Short-tailed Ground-tyrant

Muscigralla brevicauda Lafresnaye and D'Orbigny

This bird was not known to be imposed upon by the shiny cowbird until very recently, when Marchant (1958, p. 384; 1960, pp. 372, 584) listed it as a host of the Ecuadorian race of the parasite *M.b. aequatorialis* in the Santa Elena peninsula of southwestern Ecuador. Out of 36 nests observed, only a single case of parasitism was noted. In this nest there were three young cowbirds.

Fork-tailed Flycatcher

Muscivora tyrannus (Linnaeus)

Known as a frequently used fosterer of the nominate form of the shiny cowbird in Argentina, the fork-tailed flycatcher has now been noted in a similar capacity in eastern Brazil, where Chagas (in litt.) found it to be parasitized in the state of Minas Geraes. All the records have to do with the nominate race of the fork-tailed flycatcher.

In a study of Venezuelan birds, Friedmann and Smith (1955, p. 507) pointed out how surprisingly little has been published on the nesting of this wide-ranging flycatcher other than in the Argentine habitat of its nominate race. Such a situation probably accounts for the absence of records of cowbird parasitism in the more northern parts of its range; it is very unlikely that the fork-tailed flycatcher is left unmolested by the shiny cowbird in these regions.

Kiskadee Flycatcher

Pitangus sulphuratus (Linnaeus)

To the few previously noted records from Argentina may be added the report by Harrison (1950, p. 6) that he found a "substantial" number of victimized nests in Uruguay. On geographic grounds, these Uruguayan records refer to the subspecies *bolivianus* of the host. Recently, in the state of Minas Geras, Brazil, Chagas (in litt.) has found that the subspecies *maximiliani* is also victimized by the shiny cowbird. The nominate race, *M.b. bonariensis*, is involved in all of these cases.

Superciliated Wren

Thryothorus superciliaris (Lawrence)

In the Santa Elena peninsula of southwestern Ecuador, Marchant (1960, pp. 377, 585) found that the superciliated wren was victimized frequently by the shiny cowbird (subspecies *M.b. aequatorialis*). Of

five nests found in 1958, all were parasitized; of three found in the same area in 1957, one or two were similarly affected. The high incidence of parasitism on this species, taken in consideration with the number of other, unmolested, but apparently suitable, potential hosts in the immediate area, suggests pronounced preference on the part of the parasites for this wren. The record refers to the nominate race of the host.

South American House Wren

Troglodytes musculus Naumann

One additional subspecies of the wren, *T.m. tobagensis*, has been found to be parasitized by the shiny cowbird (subspecies *M.b. minimus*). In Tobago, at Caledonia, on October 29, Mees (Junge and Mees, 1958, p. 127) twice saw a fledgling cowbird being fed by adults of this species. A second record for the Chilean race of the wren (*T.m. chilensis*) recently has been reported—a nest with 4 eggs of the wren and 3 of the cowbird (subspecies *M.b. bonariensis*) found at Vucro de Linares in November, 1948, by R. Barros Valenzuela (1956, p. 91). The eggs of the wren had been punctured, apparently by the cowbird.

In Peru, the subspecies *T.m. audax* was known as a host of the shiny cowbird (subspecies *M.b. occidentalis*) only on the basis of Taczanowski's statement (1884, pp. 422–424) that it had been reported as such by Stolzmann and Jelski. Recently, Dr. Maria Koepcke has informed me that near Lima she has seen a recently fledged cowbird attended by a pair of house wrens. Howe and Singh (1960, pp. 94, 95) considered this wren (subspecies *clarus*) as the favorite and, indeed, the only recorded host in British Guiana, as did Harper (1907, p. 66) years earlier. Similarly Haverschmidt (1955, p. 127) concluded that this bird was the principal host in Surinam; he informed me (in litt.) of 11 instances that had come under his own observation there. In Trinidad, Herklots (1961, p. 222) reported frequent impositions on this wren; he wrote that several nests had been found each with from 1 to 3 eggs of the shiny cowbird.

The frequent choice of this host by the parasite in northeastern South America is noteworthy in view of the fact that in Argentina, Paraguay, and Uruguay *Troglodytes musculus* is victimized much less commonly. Even in these more temperate southern latitudes, however, this wren is parasitized more frequently than its counterpart, *Troglodytes aedon*, is parasitized anywhere in North America by the brown-headed cowbird.

Long-tailed Mockingbird

Mimus longicaudatus Tschudi

The subspecies *albogriseus* of this species of mockingbird has been added to the list of victims of the shiny cowbird (subspecies *M.b.*

aequatorialis). In the Santa Elena peninsula of southwestern Ecuador Marchant (1958, p. 384; 1960, p. 380) found two parasitized nests. He also saw, on one occasion, a fledged young cowbird being attended by one of these mockingbirds (1960, p. 584). The nominate race of the long-tailed mockingbird was previously known as a host of the shiny cowbird (subspecies *M.b. occidentalis*) in Peru (Friedmann, 1943, p. 351).

White-banded Mockingbird

Mimus triurus (Vieillot)

Already known as a common victim of the shiny cowbird in Mendoza and San Luis provinces, the white-banded mockingbird was noted as the most frequently imposed upon fosterer in Pampa province as well, according to Pereyra (1937, p. 289). The frequency with which the shiny cowbird parasitizes mockingbirds in Argentina is a puzzling contrast to the tendency of the brown-headed cowbird to leave the North American mockingbird unmolested in the southern United States.

Chilean Robin

Turdus falklandii Quoy and Gaimard

R. Barros Valenzuela (1956, p. 92) has recorded the Chilean subspecies of this thrush, *T.f. magellanicus*, as a victim of the shiny cowbird in Chile. This is an addition to the known hosts. In view of the recent spread of the shiny cowbird in various parts of central Chile, it may be anticipated that additional hosts will be reported from that country.

Spix's Thrush

Turdus leucomelas (Vieillot)

To the few earlier records of the northern race of this thrush (*T.l. albiventer*) as a host of the Venezuelan subspecies of the shiny cowbird (*M.b. venezuelensis*) may be added another—a nest with 2 eggs of the host and 2 of the parasite. This was found at Casa Blanca, Venezuela, on April 17, and was recorded by Gilliard (1959, p. 26), who wrote that this thrush is frequently imposed upon in that area.

Brush Gnatcatcher

Polioptila dumicola (Vieillot)

In my original study (1929, p. 110), I noted that, while Hudson had listed this gnatcatcher as a victim of the shiny cowbird in Argentina, he gave no specific records or details. Harrison (1950, p. 6) now has published a definite record, which removes the earlier uncertainty attached to this bird as a molothrine host. The nominate race of both the host and the parasite are involved here.

Yellow-green Vireo

Vireo flavoviridis (Cassin)

Marchant (1958, p. 384; 1960, p. 382, 584) has reported that the Ecuadorean race of the shiny cowbird, *M.b. aequatorialis*, parasitizes the local race (*V.f. griseobarbatus*) of this vireo in the Santa Elena peninsula, southwestern Ecuador. He noted that 7 nests of this vireo succeeded and 6 failed, and of these failures, 3 were due ostensibly to parasitism by the cowbird.

Ochre-fronted Vireo

Hylophilus aurantiifrons Lawrence

One subspecies of this vireo, *H.a. saturatus*, was previously recorded, on the the basis of two records (Friedmann, 1938, p. 44), as a victim of the shiny cowbird in Trinidad. Recently, Mr. R. Kreuger has informed me that he possesses five parasitized sets of eggs of this bird, all from Trinidad and all collected by Smooker, who had collected the two earlier records. It seems probable that the first two are included in the five cases. With such an increase in known instances of parasitism, it now would appear that this vireo is locally a regular host of the shiny cowbird.

Cayenne Dacnis

Dacnis cayana (Linnaeus)

At Caroni Swamp, Trinidad, on July 18, 1932, G. D. Smooker found a nest of this bird containing 2 eggs of the shiny cowbird and 1 of its own. The set is now in the collection of R. Kreuger of Helsinki, to whom I am indebted for this record. The species was not previously known as a cowbird host. The nominate race of the host and the race *M.b. minimus* of the parasite are involved.

Bicolored Ateleodacnis

Ateleodacnis bicolor (Vieillot)

Previously known, on the basis of a single record (Friedmann, 1938, p. 44), as a host of the shiny cowbird in Trinidad, this little-known species of honey-creeper now has been found to be parasitized also in Surinam. Haverschmidt (in litt.) informs me that on February 28, 1953, in the vicinity of the Corentyne River near Nickeries, he observed a recently fledged shiny cowbird being attended and fed by one of these honey-creepers. This observation adds it to the list of hosts known to have reared the parasite; the former record was one of eggs only. It should be pointed out that the Trinidad record may not be wholly satisfactory when one considers the uncertain aspects of our knowledge of the nesting habits of this honey-creeper. (See Belcher and Smooker 1937, p. 520.) Both records here refer to the nominate race of the host and to the small, northeastern race of the parasite, *M.b. minimus*.

Golden Warbler

Dendroica petechia (Linnaeus)

Mrs. F. C. K. Anderson wrote me the following: she had been told by a friend who was interested in birds that on two occasions he had seen young fledgling shiny cowbirds being fed by a pair of these warblers near Bridgetown, Barbados. Pinchon and Bon Saint-Come (1951, p. 273) also have noted this warbler as a cowbird fosterer, and, on the strength of their comments, Bond (1951), p. 20) in turn has mentioned it. These records refer to the race *ruficapilla* of the warbler and to the race *minimus* of the cowbird.

Imthurm's Grackle

Macroagclaius subalaris (Boissonneau)

On the basis of a parasitized set of eggs in the C. J. Marinkelle Collection, The Hague, Netherlands, this grackle (race *M. s. imthurmi*) may be added now to the list of victims of the shiny cowbrid (race *M.b. minimus*). The set is said to have been collected in the Guianas, but exact data are not available to me.

Swainson's Grackle

Holoquiscalus lugubris (Swainson)

Previously known as a victim of the shiny cowbird in Trinidad *M.b.* (*minimus*), this grackle has been found to be the commonest victim of the Venezuelan subspecies of the parasite (*M.b. venezuelensis.*) Foster D. Smith (Friedmann and Smith, 1955, p. 514) discovered that in northeastern Venezuela the shiny cowbird parasitized the nominate race of this grackle not just frequently but apparently exclusively. Smith noted that about a quarter of the young which accompainied the grackles to his feeding station were cowbirds. Later, while still in juvenal plumage, the cowbirds left the grackle flocks and joined flocks of adults of their own species. This is one of the relatively rare cases of a frequently imposed upon host which is considerably larger in size than the parasite.

Martinique Oriole

Icterus bonana (Linnaeus)

This oriole is an addition to the known victims of the West Indian race of the shiny cowbird (*M.b. minimus*). Pinchon and Bon Saint-Come (1951, p. 273) record it as being parasitized in Martinique.

Moriche Oriole

Icterus chrysocephalus (Linnaeus)

A single record, from Surinam, of this hitherto unrecorded host is in the collection of Dr. C. J. Marinkelle, to whom I am indebted for

the information. The cowbird involved is the small northern race *M.b. minimus.*

Grace's Oriole

Icterus grace-annae Cassin

Marchant (1960, p. 586) recently has added this oriole to the list of hosts of the shiny cowbird in southwestern Ecuador. He found a nest in March, 1958, containing five young birds, "three of which later observations showed were cowbirds: one young oriole died in the nest when more than seven days old and well-feathered, but I was uncertain of the fate of the other. It would have been most exceptional if it had survived in such a heavily parasitized nest. Both adult orioles were feeding the young. When empty, I found a pale blue, very faintly spotted, unhatched egg in the nest, presumably another cowbird egg, since those of the genus *Icterus* are bluish white, more or less heavily marked with chocolate and brown." The race of shiny cowbird involved is *M.b. aequatorialis.*

Lesson's Oriole

Icterus chrysater (Lesson)

Dr. F. C. Lehman V. (in litt.) recently informed me that a nest of this oriole containing a shiny cowbird's egg was found at El Tambo, Cauca, Colombia, in 1938. The cowbird there is of the race *M.b. cabanisi*; the oriole, *I.c. giraudii.* There are no previous records of this oriole as a cowbird host.

Black-throated Oriole

Icterus nigrogularis (Hahn)

This oriole was previously known as a victim of the Colombian race of the shiny cowbird, *M.b. cabanisii,* and of the race *M.b. minimus* in Trinidad and in Dutch Guiana. It has since been reported in Venezuela by Giñes, Avelado, et al (1951, p. 303) as a host of the local race *M.b. venezuelensis.* The Trinidad and Guiana records refer to the local race of the oriole (*I.n. trinitatis*), the others to the nominate subspecies.

Orange-backed Oriole

Icterus jamacaii croconotus (Wagler)

Dr. C. J. Marinkelle informed me (in litt.) that he has in his collection a set of eggs of the orange-backed oriole with a shiny cowbird egg which was collected in British Guiana. The cowbird is of the subspecies *M.b. minimus.* I know of no other record for this host.

Red-breasted Blackbird

Leistes militaris (Linnaeus)

The southern race *L.m. superciliaris,* previously (Friedmann, 1938, p. 45) known from only two records, is apparently a frequent host of

the shiny cowbird in the province of Pampa, Argentina, where Pereyra (1937, p. 297) noted that it was unusual to find an unparasitized nest of this bird.

To the northern, nominate race of the red-breasted blackbird should be referred a record of cowbird parasitism in Surinam, first cited by me (1929, p. 120) on the basis of the Penards (1910), as *Lampropsar tanagrinus guianensis*. I am indebted to Dr. Francois Haverschmidt for correcting this old, erroneous identification.

Red-breasted Starling

Pezites militaris (Linnaeus)

A single instance of this bird as a victim of the shiny cowbird in southwestern Ecuador was recently reported by Marchant (1960, p. 584). The local race of the parasite is *M.b. aequatorialis*; the host is *P.m. bellicosa*.

Palm Tanager

Thraupis palmarum (Wied)

To the previous single record known to me (Friedmann, 1934b, p. 345) may be added the data that Chagas (in litt.) found this tanager to be a victim of the shiny cowbird in Minas Geraes, Brazil. Both records have to do with the typical race of the parasite and of the tanager.

Brazilian Tanager

Ramphocelus bresilius (Linnaeus)

In Rio de Janeiro province, Brazil, Sick and Ottow (1958, p. 45) found two parasitized nests of this tanager (subspecies *dorsalis*)—one with 3 eggs of the host plus 1 of the shiny cowbird, on November 22; the other with 2 eggs of the tanager plus 1 of the parasite, on December 7. These additions to the very few previous records make it appear that this tanager may be a fairly regular victim.

Greater White-shouldered Tanager

Tachyphonus rufus (Boddaert)

A second record of this tanager as a host of the Venezuelan race of the shiny cowbird recently has been published. Near Caracas on April 24 Gilliard (1959, p. 29) found a nest with 1 egg of the host and 1 of the cowbird. According to information kindly sent me by F. C. Lehmann V, a hitherto unpublished case of this bird as a host of the Colombian race of the parasite was found in 1961 on a farm near Bitaco, west of Cali, by Alfred Kyburz.

Golden-bellied Grosbeak

Pheucticus chrysopeplus (Vigors)

Marchant (1960, p. 584, 587) found eggs of the shiny cowbird subspecies *M.b. aequatorialis*) in two nests of this grosbeak (sub-

species *P.c. chrysogaster*) in southwestern Ecuador. No previous instances of cowbird parasitism on this bird are known.

Antillean Bullfinch

Loxigilla noctis (Linnaeus)

According to information sent me by Mrs. F. C. K. Anderson of the Barbados Museum and Historical Society, 1 egg of the shiny cowbird (*M.b. minimus*) was found in a nest of this finch near Bridgetown, Barbados. This is the second record for this host (race *L.n. barbadensis*).

Chestnut-bellied Rice Grosbeak

Oryzoborus angolensis (Linnaeus)

According to Chagas (in litt.), this finch is victimized by the shiny cowbird in Minas Geraes, Brazil. No previous records for the species are known. The nominate race of the finch as well as of the parasite is involved here.

Yellow Finch

Sicalis flaveola (Linnaeus)

The subspecies *S. f. pelzelni* has been recorded as a host of the shiny cowbird on only a few occasions (see Friedmann, 1929, p. 113; 1934, p. 345). It is worth noting that Pereyra (1937, p. 302) since has found it to be parasitized in Pampa province, Argentina, as has Hoy (ms., 1961) in Salta province. The latter observer found that this finch was prone to desert its nest somewhat readily when it was parasitized.

Misto Yellow Finch

Sicalis luteola (Sparrman)

On the basis of reports by Gibson and by Devincenzi, I originally listed this finch (race *luteiventris*) as a victim of the shiny cowbird in Argentina and Uruguay, but I had no further data. Harrison (1950, pp. 6–7) has since recorded an egg of the parasite from a nest of this fosterer in Argentina. Inasmuch as neither the finch nor the cowbird are local or rare, and inasmuch as the nest of the former seems in every way suitable, it is difficult to see why the misto finch is not parasitized more frequently. The nominate races of both the finch and the cowbird are involved here. The authors mentioned above refer to this finch under the name *Sicalis arvensis*.

Red-crested Finch

Coryphospingus cucullatus (P. L. S. Müller)

Near Salta, northwestern Argentina, Hoy (ms., 1961) found that this bird (subspecies *rubescens*) was parasitized rather frequently and that it deserted its nest in a number of such instances. It has

been recorded a few times previously as a host in Tucuman province and in southeastern Brazil.

Striped-headed Sparrow

Aimophila strigiceps (Gould)

I am informed by Dr. Johann Ottow that at Salta, Argentina, on December 16, 1960, Gunnar Hoy collected a set of eggs of this sparrow containing 1 egg of the shiny cowbird, thereby adding this species to the roster of known hosts of the parasite. The record involves the race *A.s. dabbenei* of the sparrow and the nominate race of the shiny cowbird.

Chingolo Sparrow

Zonotrichia capensis (P. L. S. Müller)

The recent study by Sick and Ottow (1958) has added greatly to our knowledge of the relations between the shiny cowbird and this sparrow, the parasite's commonest host in southeastern Brazil and Argentina. Working in the province of Rio de Janeiro, Sick and Ottow found 93 nests of the sparrow, of which 57, or 61 percent, were parasitized. This may be compared with Moojen's data (1938, p. 17) at Vicosa, Minas Geraes, where 75 percent of the nests were affected. In the latter province, Chagas (in litt.) has found hundreds of nests, and "almost all" contained 2, 3, or 4 eggs of the shiny cowbird, and, in one instance, as many as 14 eggs of the parasite. Allowing even for loose writing, "almost all" must signify a majority. Sick and Ottow never found more than a single egg from any one cowbird in any nest. In the course of 80 days of observations in a carefully watched "control" area about .2 kilometers square, 41 female cowbirds deposited 64 eggs. The identity, and hence, the number, of the laying birds was arrived at by a study of the coloration, size, and shell thickness of the eggs. The predilection of the shiny cowbird for the chingolo as a host is indicated further by the fact that, in the same area and during the same period of observation, only 2 nests of a tanager, *Ramphocelus bresilius*, were parasitized, and none of 31 nests of 9 other potential host species were affected.

The success of the cowbird in nests of this sparrow may be judged from that fact that 44 percent of the parasitic eggs hatched and 26 percent lived to the fledging stage, while 41 percent of the host eggs hatched and 24 percent survived to the fledging stage.

The data from Minas Geraes refer to the subspecies *Z.c. subtorquata* while the coastal data have to do with another race of the host, *Z.c. matutina*.

Dr. Maria Keopcke has recently informed me that, on 15 or more different occasions, she has seen fledglings of the shiny cowbird (race *M.b. occidentalis*) being cared for by chingolos (race *Z.c.*

peruviensis), near Lima, Peru. While there are earlier records from Peru, the number of Dr. Koepcke's instances make it clear that in that country, as in Argentina and Brazil, this sparrow is a very frequent, if not the most frequent, host.

White and Gray Warbling Finch

Poospiza melanoleuca (Lafresnaye and d'Orbigny)

Commonly parasitized by the shiny cowbird in the province of Tucuman, this finch also has been noted as a cowbird host in Salta, by Hoy (ms., 1961), who listed it as one of those fosterers which often are motivated to desert their nests by the intrusions of the parasite.

Many-colored Ground Sparrow

Saltatricula multicolor (Burmeister)

This finch, previously known as a cowbird victim from a single record in Tucuman province, Argentina, has been found recently by Hoy (ms., 1961) to be parasitized not infrequently farther north in the province of Salta. Hoy considered this bird as one of those hosts which are prone to desert their nests when they are parasitized, but he gave no actual estimates of the number of cases he observed.

La Plata Ground Finch

Embernagra platensis (Gmelin)

Hoy (ms., 1961) found that this bird was victimized not infrequently near Salta, northwestern Argentina. It was recorded previously as a host species in Paraguay and in Buenos Aires province. According to Hoy, it was caused readily to desert its nest because of the attentions of the parasite. The Salta and Paraguayan records involve the race *olivascens* and the Buenos Aires record, the nominate. All the cases involve the nominate race of the parasite.

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Screaming Cowbird

Molothrus rufo-axillaris Cassin

The host-parasite relations of this, the most primitive of the parasitic cowbirds, are quite simple. The species is parasitic only on its ancestral and very closely related non-parasitic congener, the bay-winged cowbird, *M. badius*. This relationship was first discovered by Hudson (1874, pp. 161–166) and was further elucidated and described in greater detail in my 1929 book (pp. 46–53). Unfortunately, except for a still unpublished study by Hoy and Ottow, almost nothing of importance has been added to our knowledge since then and there is no need to repeat here the details available in my earlier publication. Suffice it to say that the eggs and the nestlings of the parasite and of the host are very similar and evince no signs of interspecific competition in any way different from what would normally transpire between eggs or young of the host alone. The young of the two species grow up together in apparent amity.

Only one recent observation should be mentioned here. In the province of Salta, northwestern Argentina, Hoy (mss., 1961) found evidence that a certain amount of mutual egg destruction may take place between this species and its host. However, in view of my feeling of uncertainty as to the identification of the eggs in each of the cases he noted, it is still not clear to me which species did the egg pecking and to which species the pecked eggs belonged. Hoy has found a situation that differed from what I found in Tucuman and Entre Rios provinces, where no such frequent egg destruction was noted. It is only fair to add that Hoy and Ottow have far less of a feeling of uncertainty about this than I do. Eventual publication of their data should be of much interest and may be expected to clarify the situation.

There have been reports to the effect that the screaming cowbird was parasitic on other birds at least occasionally, but none of these cases has been authenticated, and their status is highly doubtful. Grant (1911, p. 104) wrote that he had found eggs of the screaming cowbird in nests of the yellow-breasted marsh bird, *Pseudoleistes virescens*. However, the bay-winged cowbird has been known to breed in old nests of this species, and Grant admitted that he had found *Pseudoleistes* nests with nothing but cowbird eggs in them. Since the eggs of the bay-wing and of the screaming cowbird are distinguishable only with difficulty, the identification of these eggs as the latter species is not certain. In this connection, it may be recalled

that, many years earlier, Hudson (Sclater and Hudson, 1888, vol. 1, p. 97) once saw two young "bay-winged cowbirds" following and being fed by a yellow-breasted marsh bird. This originally caused Hudson to assume that the bay-wing was occasionally parasitic, but later, as he learned of the parasitic breeding of the screaming cowbird, he felt that this observation must have been of two fledglings of that species. This is the most nearly "evidential" observation on record for *M. rufo-axillaris* parasitizing any birds other than *M. badius*. By itself it is not too good, as young cowbirds are apt to beg for food from adults that did not rear them and very frequently succeed in getting fed by them.

On the basis of eggs collected by Pablo Girard in western Argentina, Pereyra (1938, p. 260) listed half a dozen other species of birds as hosts of *M. rufo-axillaris*—an ovenbird, *Furnarius rufus;* an ant shrike, *Taraba major;* a flycatcher, *Pitangus sulphuratus;* a mocking bird, *Mimus saturninus;* a thrush, *Turdus rufiventris;* and a finch, *Sicalis pelzelni;* but these seem almost certainly to be misidentified records of *M. bonariensis*, a species which is known to parasitize all of these birds.

Giant Cowbird

Psomocolax oryzivorus (Gmelin)

The giant cowbird is related to the bronzed cowbird stock, from which it differs chiefly by its much greater size and by the more developed "cape" feathers. Apart from one recent observation (Lehman, 1960), it is known to be parasitic only on other icterine birds of the oropendola and cacique group, and, while the situation needs further investigation, enough is known to make it apparent that the range of host choice is usually restricted to these birds. All of these fosterers have in common the habit of colonial nesting: many of their long, woven, pouch-like nests are suspended from the branches of a single tree. In its restricted range of hosts the giant cowbird is more like the screaming cowbird, *M. rufo-axillaris*, than it is like the bronzed cowbird. The latter, as stated earlier, is predominantly parasitic on icterine species, chiefly orioles, but has extended its parasitism to include many other birds as well (see pp. 173-188).

We may recall that the bronzed cowbird, *Tangavius*, is considered an evolutionary offshoot of the stock represented by the screaming cowbird, which is parasitic entirely on one species, the closely related bay-winged cowbird. I have long considered it probable that the phyletic arrangement between these three cowbirds would rank them thus: *M. rufo-axillaris* as the most primitive, then *Tangavius*, and then *Psomocolax*. However, the fact that there is greater similarity in restricted host dependence between the large *Psomocolax* and the smaller *M. rufo-axillaris* than there is between either of them and *Tangavius* raises the possibility that the giant cowbird may be a very large derivative from the screaming cowbird line, and that it, in turn, gave rise to the more "normal" sized bronzed cowbird stock. The present geographical distribution of the three would support such a possible interpretation. The screaming cowbird occurs from central Argentina north to extreme southern Brazil and to Paraguay; the giant cowbird ranges from northeastern Argentina, Paraguay, eastern Bolivia, and southern Brazil to Mexico; while the bronzed cowbird is found in Colombia, and again from western Panama, north through Costa Rica, Nicaragua, El Salvador, Guatemala, and Mexico to Texas and Arizona. The chief difficulty in this conception of relationships is that we have to accept a giant form between two smaller ones. The evidence, if it may be dignified by such a term, is not at all conclusive, but merely suggestive. If one

merely examines specimens of the three, the giant species would certainly be looked upon as a climax development and not as an intermediate one. Ethologically and geographically, the data are more readily arranged with the giant form in the middle.

In keeping with its large size, the giant cowbird parasitizes large hosts. Although it occurs over a vast range and is not a rare bird in many areas, *Psomocolax* remains a very inadequately studied species. Indeed, since my 1929 account, little really new or significant information has been added to our knowledge of its breeding habits. However, Belcher and Smooker (1937, pp. 525–526), Skutch (1954, pp. 316–320), Tashian (1957, pp. 87–97), Schäfer (1957, pp. 135–138), and Lehmann (1960, pp. 272–273) have added welcome supplementary observations on its habits in Trinidad, in Central America, in Venezuela, and in Colombia.

Seven species have been recorded as hosts of the giant cowbird, four of which are listed in my earlier account.

green jay, *Cyanocorax yncas* (Boddaert)
Wagler's oropendola, *Zarhynchus wagleri* (Gray and Mitchell)
Montezuma oropendola, *Gymnostinops montezuma* (Lesson)
crested oropendola, *Xanthornus decumanus* Pallas
green oropendola, *Xanthornus viridis* (P. L. S. Müller)
yellow-rumped cacique, *Cacicus cela* (Linnaeus) *
red-rumped cacique, *Cacicus haemorrhous* (Linnaeus).

* *Cacicus persicus*, previously listed as a host, is now considered to be a synonym of *C. cela*.

The recent addition of so unexpected a bird as the green jay to the known hosts by Lehmann (1960, p. 273) can only be looked upon, in light of current knowledge, as an unusual host choice. The green jay makes an open, saucer-shaped nest of twigs and rootlets, often placed in the denser portions of the foliage of the trees in which they are built, a very different type of nest from the long, conspicuous, pendant nests of the oropendolas.

Lehmann watched a pair of these jays attending and feeding a recently fledged giant cowbird in August 1957, at Cajibio, Cauca, Colombia. He observed these three birds together repeatedly on several mornings as they came to feed in his garden. No young jays were seen with them. The fact that the observation was of some duration indicates that it was a real foster parent-young relationship. (If it had been a single casual observation, the possibility would have remained that the young parasite might not actually have been reared by the jays but that it had begged for food from them and had succeeded in obtaining their temporary response and attention. Such occurrences are known to happen not infrequently with the smaller cowbirds and even with fledglings of non-parastitic species.)

Chapman (1928, pp. 152–154) and Skutch (1954, pp. 298, 318–319) have described something of the host relationship of the giant cowbird with two of its usual victims. Here we have a situation far more tense and militant than in the smaller cowbirds. Writing of the Montezuma oropendola, Skutch summarized his notes as follows: "The Giant Cowbird who lays in an oropendola's nest meets far more opposition than the parasitic birds of other species which lay their eggs in the nests of small birds which breed in isolated pairs. The Giant Cowbird that finally succeeds in laying in an oropendola's nest must not only dodge the watchful oropendolas of both sexes, but sometimes she must also outwit jealous rivals of her own species, each eager to drop her own eggs into the newly finished nest and ready to drive away another cowbird who attempts to get ahead of her. It costs the cowbirds so much effort to foist their eggs on the oropendolas that I suspect that it would involve very little more labor for them to build some simple nest and rear their own young.

"Had the oropendolas made a concerted attack upon these unbidden guests, they might have driven them permanently from the nest tree; but they are mild mannered birds and seemed to be content merely to prevent entry of the cowbirds into their nests . . . ."

Skutch once saw a giant cowbird enter the nest of a Montezuma oropendola. A few minutes later he saw an oropendola emerge, carrying a giant cowbird egg in her bill. She dropped the egg, which landed on the ground, unbroken by a fall of some 80 feet. Skutch was able to measure it and found it agreed with published dimensions of eggs of this parasite.

All oropendolas are not as discerning or as hostile as this one, and the species does at times accept the strange egg and rears the young parasite.

Studying Wagler's oropendola, Chapman concluded that these birds appear to recognize the giant cowbird as an enemy "not only when she seeks to enter a nest, but when, early in the nesting-season, she enters the nest tree. Not alone the bird whose nest is threatened but other birds in the same group, and also from other groups, join in attacking her; while *Legatus* assails at times with more zeal than *Zahrynchus*." It may be added here that *Legatus* is a small flycatcher that usurps the nests of the much larger oropendolas, and then breeds in them. This is the case of a nest robber driving away a nest parasite even while the nest is still in the possession of its original builder and owner.

The above observations on the hostility toward the giant cowbird shown by these colonial nesting icterids reminds one of the comparable situation that occurs between the brown-headed cowbird and the redwinged blackbirds, which nest in rather closely integrated groups

in cattail swamps. In the latter host-parasite relationship, the parasite is successful only, or chiefly, with those redwings which nest at wider intervals in bushes or at the periphery of a colony.

The pugnacity and persistence often displayed by the giant cowbird when attempting to gain entry into the nests of its intended victims is of some interest. This parasite is related to the bronzed cowbird and, more remotely, to the screaming cowbird, a species which is also quite pugnacious and resolute when about to enter a nest. The shiny and the brown-headed cowbirds are more timid and are more apt to sneak in while the owners are absent.

The number of eggs laid by a giant cowbird in any one nest seems to be usually 1 or 2. Schultz, as reported by Kuschel (1896, p. 585), recorded as many as 6 eggs of the giant cowbird in a single nest of the yellow-rumped cacique near Para, Brazil, but some doubt may be attached to this statement, as Kuschel's description of the eggs, which are supposed to be those of giant cowbirds, do not agree very closely with others subsequently collected.

Many years ago in Brazil, Goeldi (1894, 1897) found that the young giant cowbird did not starve out or otherwise eliminate a nest-mate of the host's species (at least in the case of *Xanthornus decumanus*), but that the two grew up together. Crandall (1914, p. 338, 342) found a parasitized nest of each of the two chief host species in Costa Rica, *Zarhynchus wagleri* and *Gymnostinops montezuma*, each of which contained a nestling giant cowbird together with one of the host young. In both instances the disparity in appearance of the parasite and its nest-mate was very striking, but in both cases the adult fosterers attended them equally. In British Guiana, Young (1929, p. 256) also noted that the nestling of the giant cowbird and that of its host developed together without obvious hostility. Skutch noted that he never found fledgling giant cowbirds in flocks of oropendolas but only with an individual foster parent. He was led to ask, ". . . can it be that the other oropendolas will not tolerate the presence of these intruders and that the foster mother prefers to lead a lonely life along with her foster young rather than desert it?"

In British Guiana, Young (1929, pp. 251–253) concluded that the giant cowbirds seemed to lay 2 eggs in nests of the crested oropendola, *Xanthornus decumanus*, and in nests of the yellow-rumped cacique, *Cacicus cela*, but he did not make it clear whether his evidence pointed to the same hen laying 2 eggs in each nest or to two individuals depositing 1 each. He found the yellow-rumped cacique to be imposed upon frequently and he noted that the young parasites grew up together with, not at the expense of, their rightful nestmates. Unlike Skutch's experience in Central America, Young saw flocks of yellow-rumped caciques accompanied by both their own young and

that of giant cowbirds. He also noted that there was no evidence to even suggest that the adult *Psomocolax* attempted to destroy or to remove eggs of its victims. He found *Cacicus cela* was parasitized to a greater extent than *Xanthornus decumanus*, but, unfortunately, he gave no actual figures for either.

In Venezuela, Schäfer (1957, pp. 135–138) found that *Xanthornus decumanus* was parasitized by the giant cowbird, but he found no evidence that another local oropendola, *X. angustifrons*, was so affected, even in mixed colonies. This may reflect a selectivity on the part of the parasite, or a greater degree of nest protection on the part of *X. angustifrons*, or it may be merely that the total observational data is incomplete.

Although the giant cowbird is intermediate in size between these two frequent victims, it lays an egg considerably smaller than either of them. *Psomocolax* eggs average 28.6 x 19.2 mm.; those of *Cacicus cela*, 32.5 x 24.5 mm.; and those of *Xanthornus decumanus*, 33.8 x 24.1 mm. In this respect, *Psomocolax* is unusual since, in the smaller cowbirds, *Molothrus* and *Tangavius*, the parasites' eggs are ordinarily larger than, or at least as large as, those with which they are placed. The problem of small egg size in proportion to body size becomes acute in the case of the European cuckoo, *Cuculus canorus*. In this species the egg weight is one-thirtieth of the body weight, whereas in 164 species of birds, as tabulated by Romanoff and Romanoff (1949, p. 63), the egg weight averages one-ninth of that of the body. It has been suggested by many writers that the small egg size here is a direct adaptation to parasitism on small fosterers, but it seems safer to say that the small egg size made it possible for the cuckoo to use many small hosts. There is no reason why *Cuculus*, had its egg been correspondingly large, could not have been parasitic on larger birds, as are the species of *Clamator*.

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